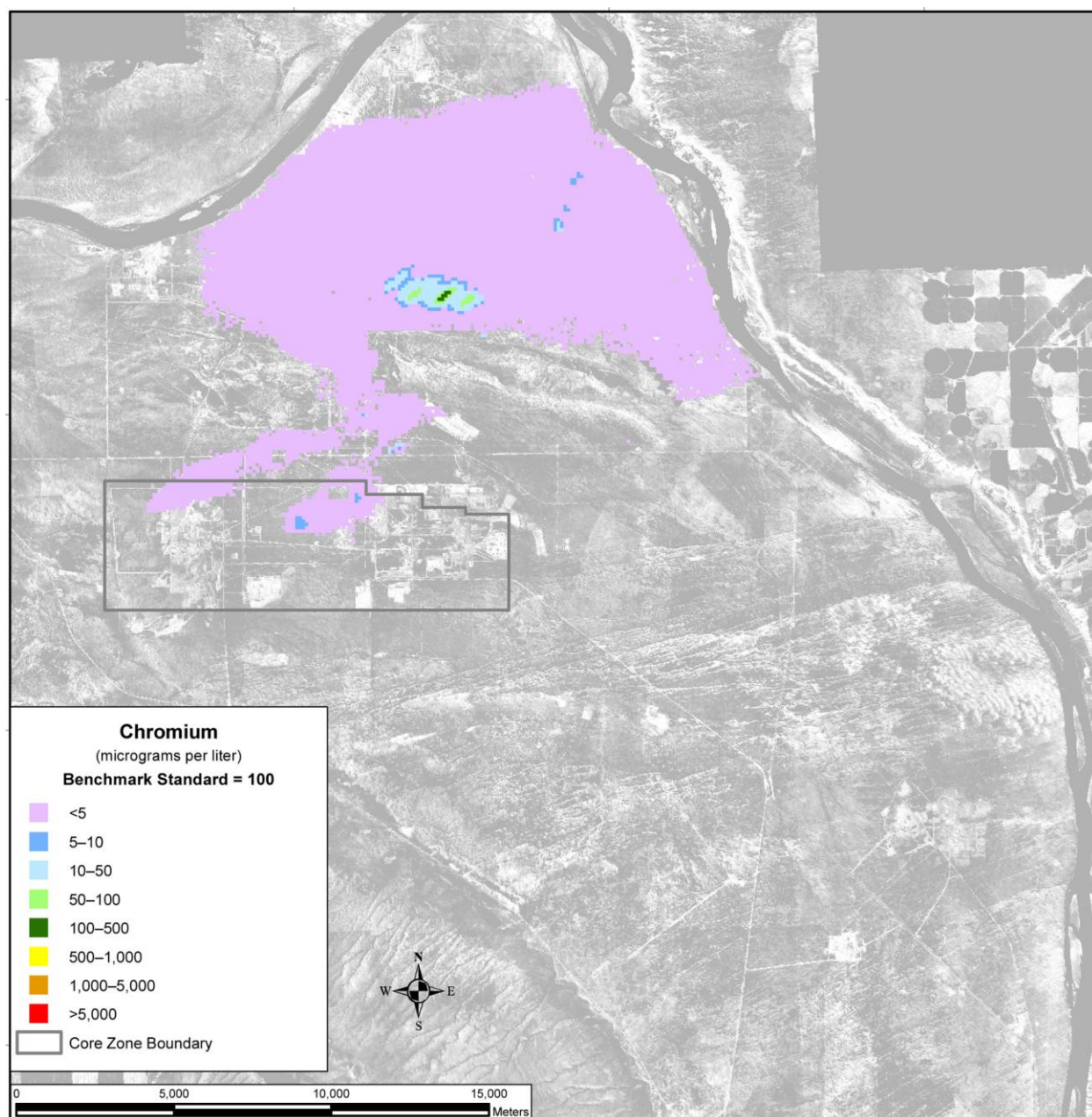
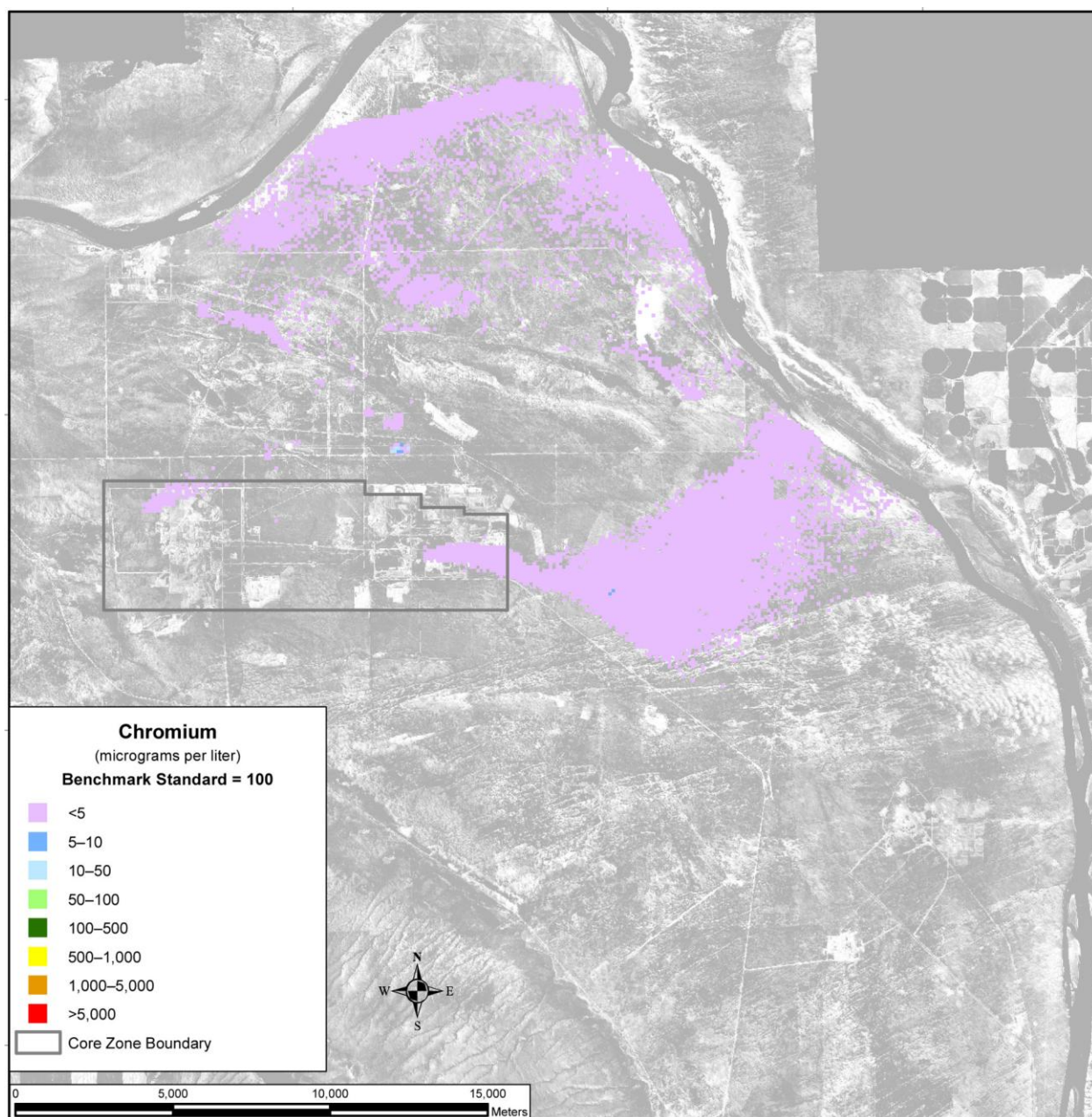


Note: To convert meters to feet, multiply by 3.281.

Figure 5–1008. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



**Figure 5–1009. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case,
Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890**



Note: To convert meters to feet, multiply by 3.281.

Figure 5-1010. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140

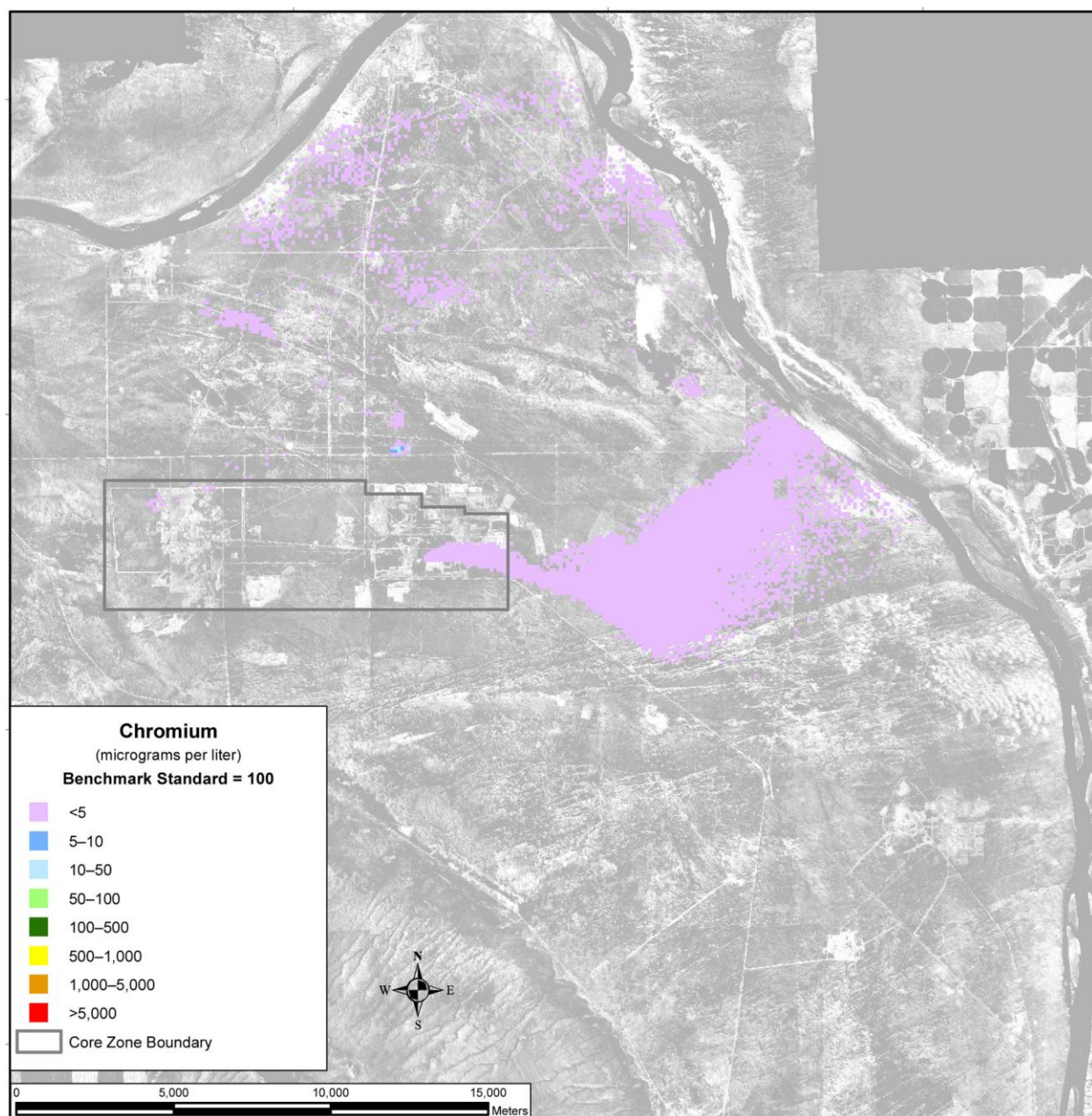
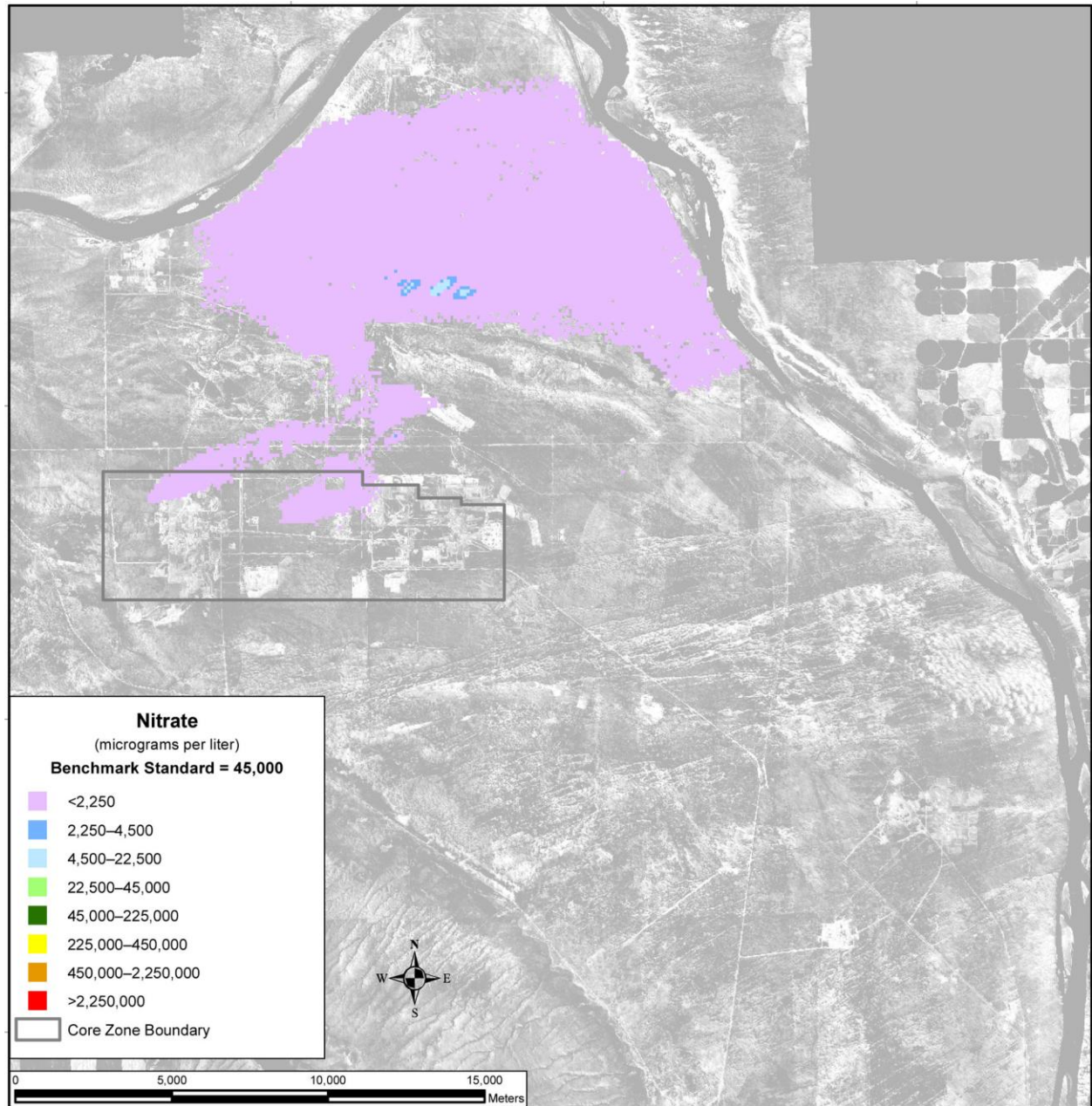


Figure 5–1011. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1012. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890

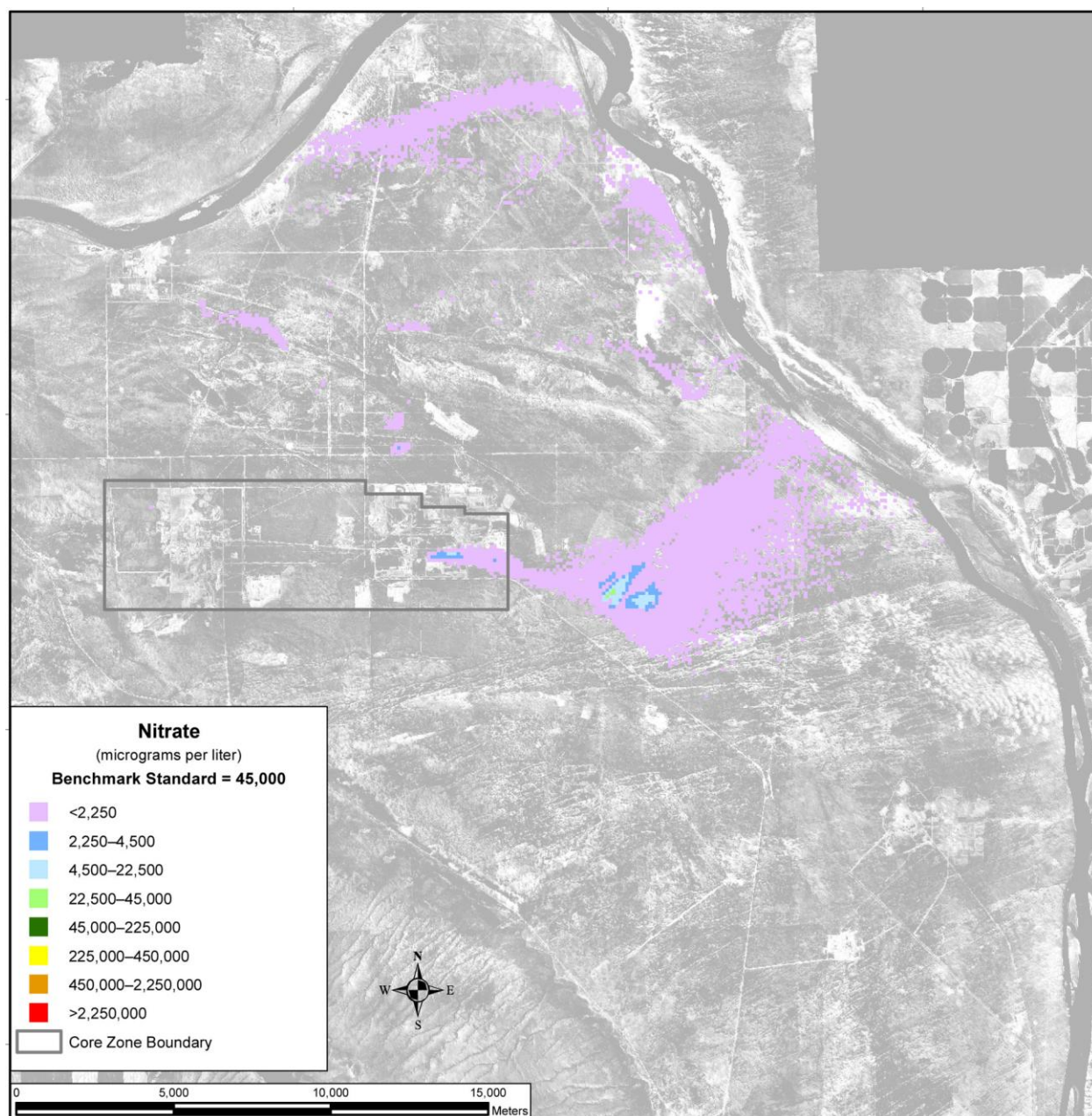


Figure 5–1013. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1014. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

Total uranium shows a different spatial distribution over time. This COPC is not as mobile as those discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–1015 shows the distribution of total uranium in CY 11,885. There is a low-concentration plume that stretches north from the RPPDF through Gable Gap. Concentrations in all areas of the plume remain below one-twentieth of the benchmark.

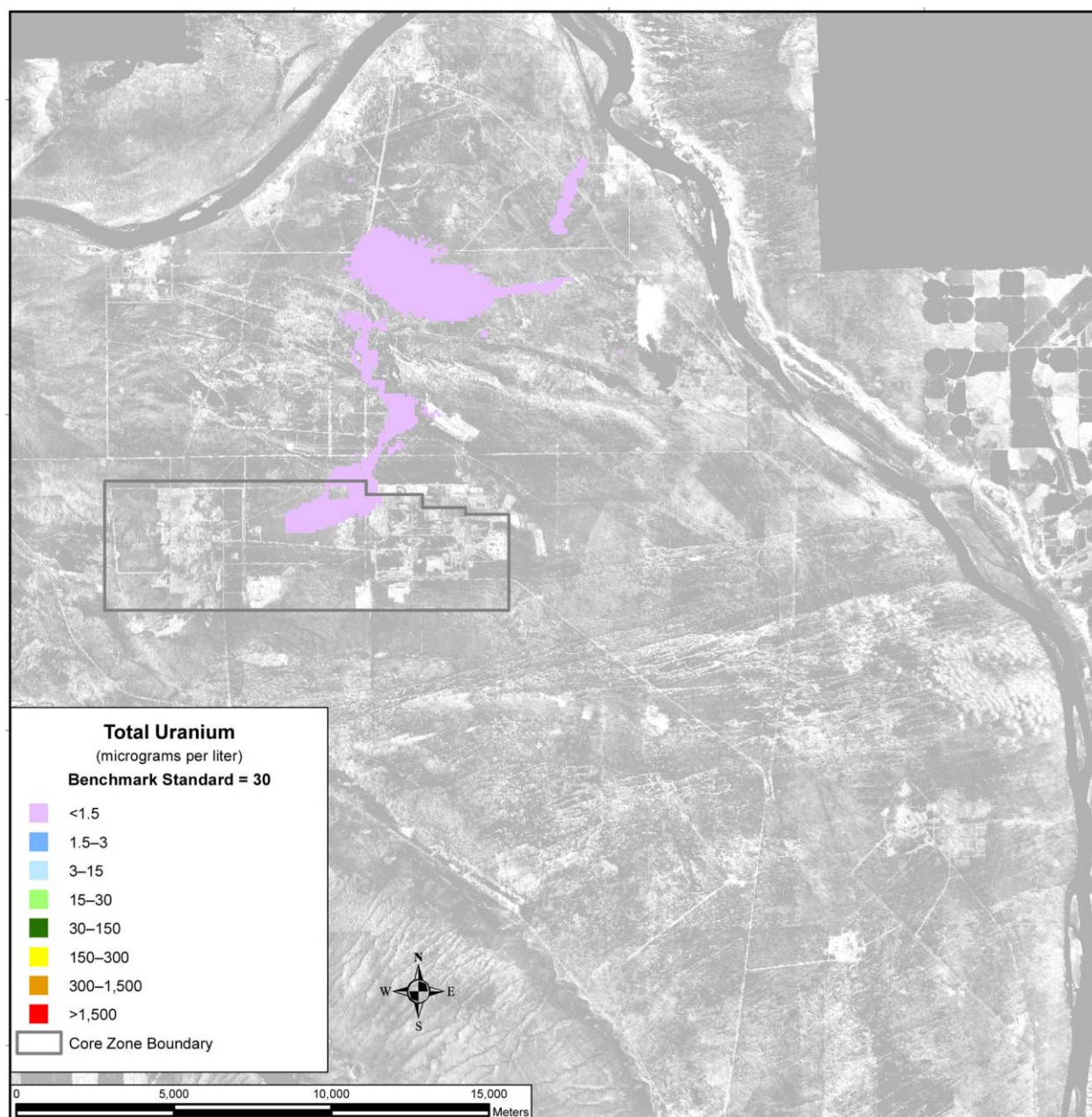


Figure 5-1015. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, in general, the inventories remaining in IDF-East and IDF-West, which are available for release to the environment at the start of the post-disposal period, are predominant contributors. The inventory available for release from the RPPDF during the post-disposal period is a secondary contributor.

For the conservative tracers, only concentrations of technetium-99 and iodine-129 exceed their benchmarks at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Both constituents exceed their benchmark standards by over one order of magnitude at the IDF-West barrier

and by less than one order of magnitude at the Core Zone Boundary and Columbia River nearshore around CY 3900.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentration of this retarded species is less than one-twentieth of the benchmark by the end of the period of analysis. The intensity is highest and the area of the contamination plume largest near the end of the period of analysis.

5.3.1.3.2.3 Disposal Group 2, Subgroup 2-B, Option Case

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, was designed to show the impacts of waste disposal at IDF-East and the RPPDF.

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6B, Option Case, and FFTF Decommissioning Alternatives 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and continue through CY 2100 for IDF-East and the RPPDF and through CY 2050 for IDF-West, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.
- The post-disposal period was assumed to start in CY 2101 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case (i.e., Tank Closure Alternative 6B, Option Case; FFTF Decommissioning Alternative 2 or 3; and onsite and offsite waste), is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, fluoride, chromium, and nitrate) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Subtotals are plotted in Figures 5–1016 through 5–1033, representing releases from the three disposal facilities: PPF glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste released from IDF-East; FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste released from IDF-West; and waste released from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over more than 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–1016 shows the release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–1017, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., all of the inventory is released during the post-disposal period). For the radioactive COPCs (technetium-99 and iodine-129), the releases range over five orders of magnitude, depending on the source. ETF-generated secondary waste and tank closure secondary waste account for most of the releases. The entire release of nitrate from IDF-East is associated with ETF-generated secondary waste. Chromium comes from ETF-generated secondary waste, tank closure secondary waste, PPF glass, and retired melters. Fluoride is not released from IDF-East.

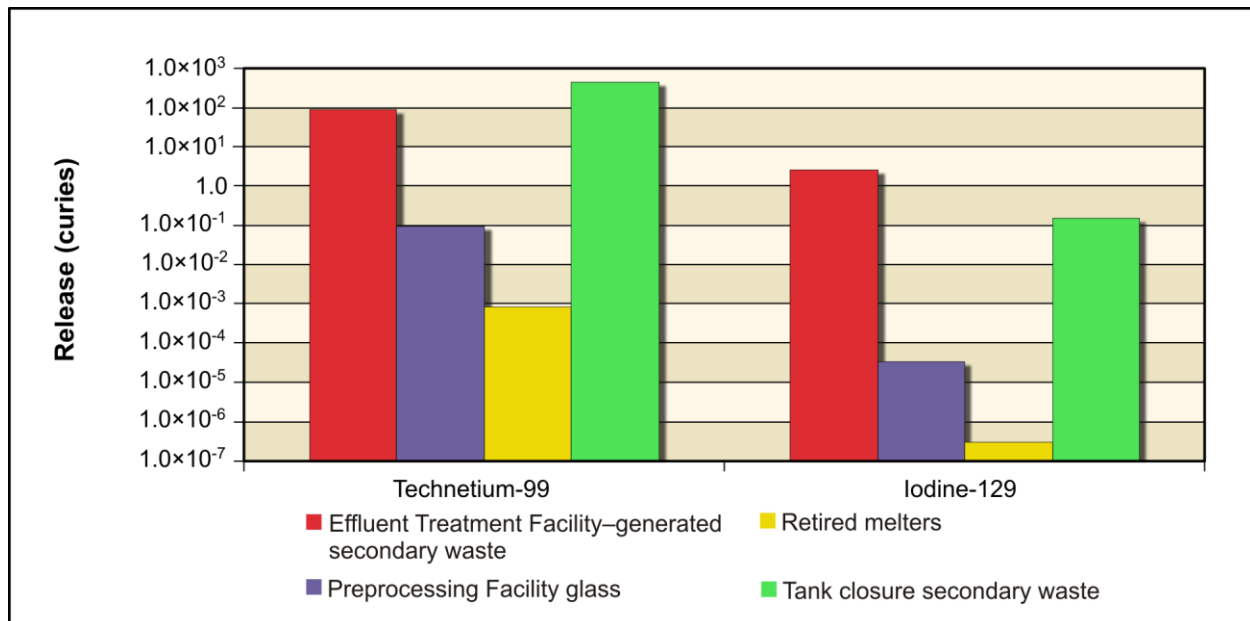


Figure 5–1016. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

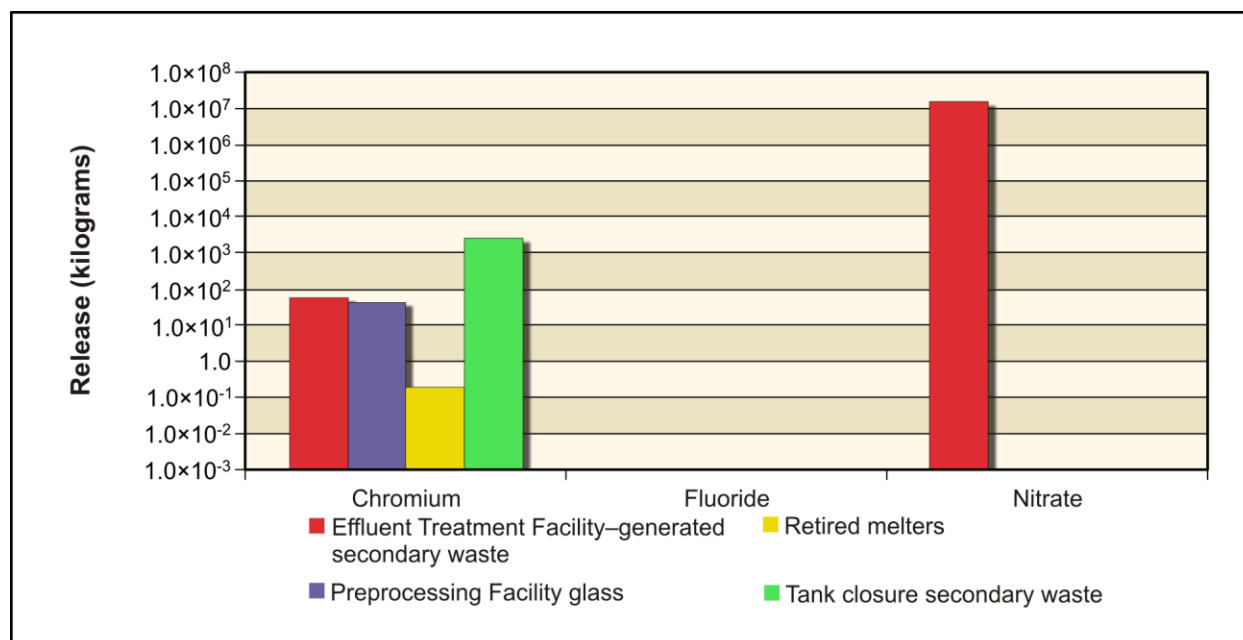


Figure 5–1017. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–1018 shows the release from IDF-East to groundwater of the radiological risk drivers and Figure 5–1019, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers iodine-129 and technetium-99, the amount released to groundwater from the vadose zone is 43 and 60 percent, respectively. For chromium and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone.

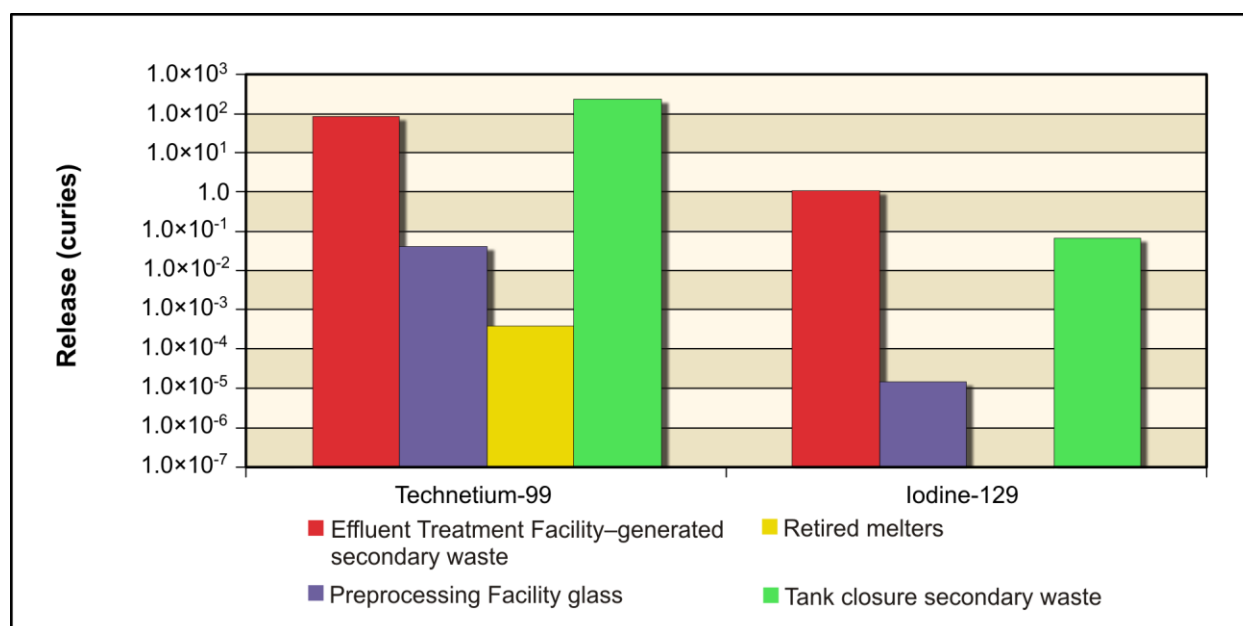


Figure 5–1018. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

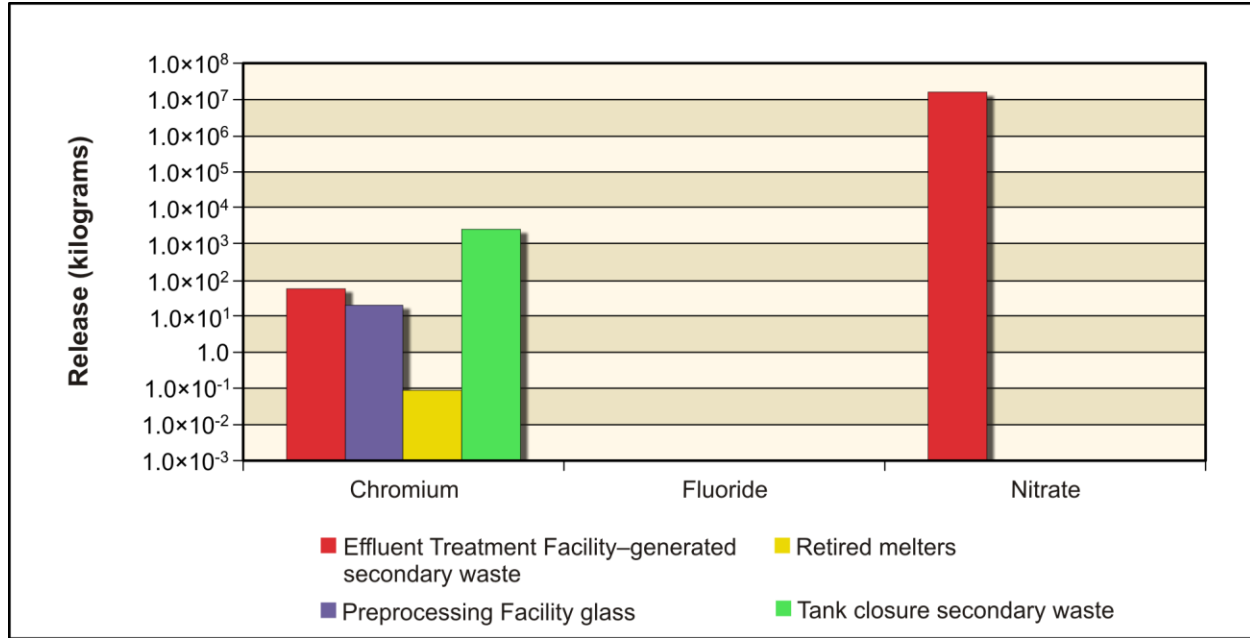


Figure 5–1019. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–1020 shows the release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–1021, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to the Columbia River is essentially equal to the amount released to groundwater.

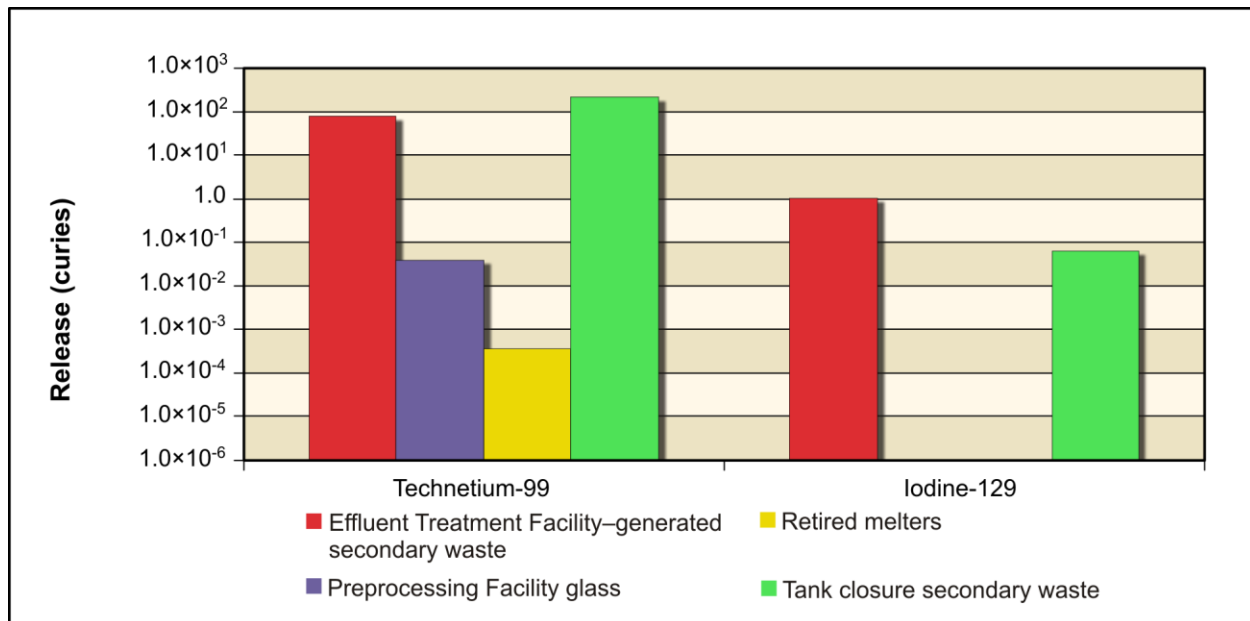


Figure 5–1020. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

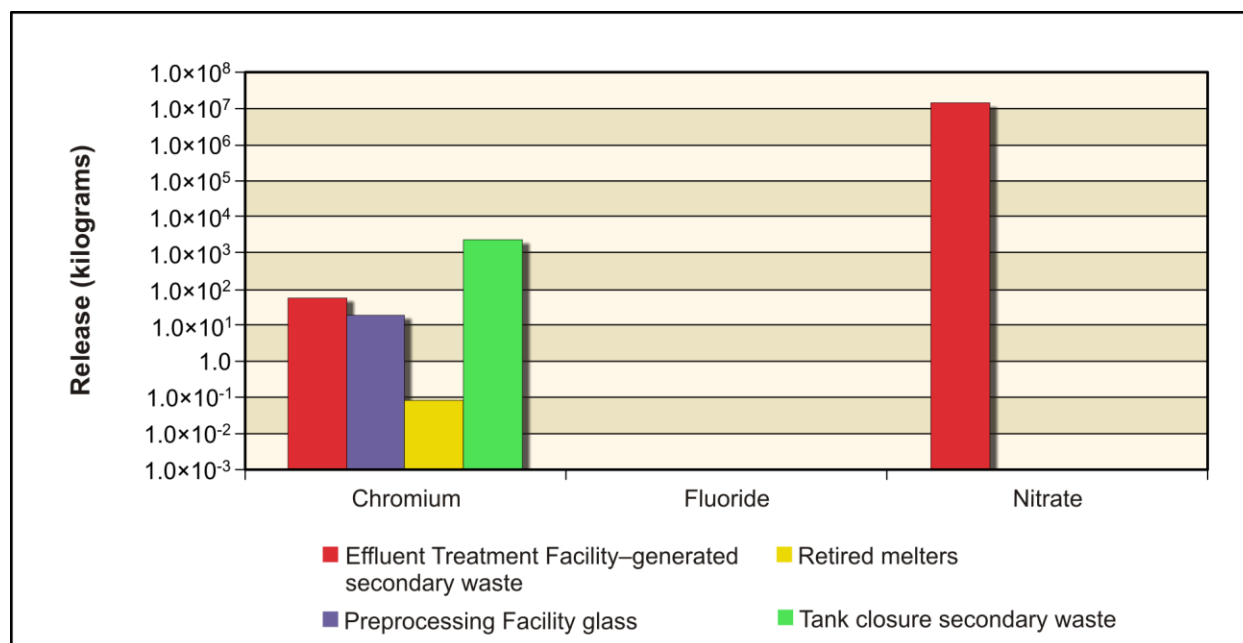


Figure 5–1021. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Figure 5–1022 shows the release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–1023, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). For the radioactive COPCs (technetium-99 and iodine-129) in IDF-West, the releases range over five orders of magnitude, depending on the source. Over 99 percent of the radioactive waste is from offsite waste. The chemical COPCs (chromium and nitrate) in IDF-West and essentially all fluoride are released from waste management secondary and onsite waste. Of the chromium sources, less than 1 percent is from FFTF Decommissioning Alternative 3 waste, 69 percent is from waste management secondary and onsite waste, and 31 percent is from offsite waste.

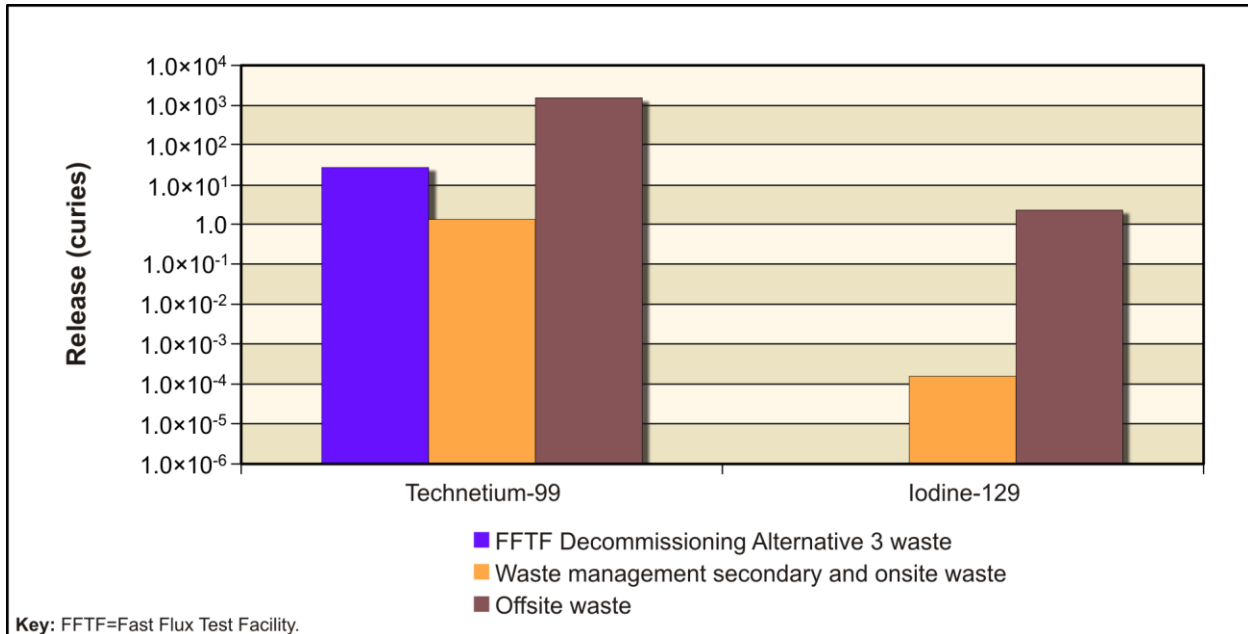


Figure 5-1022. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

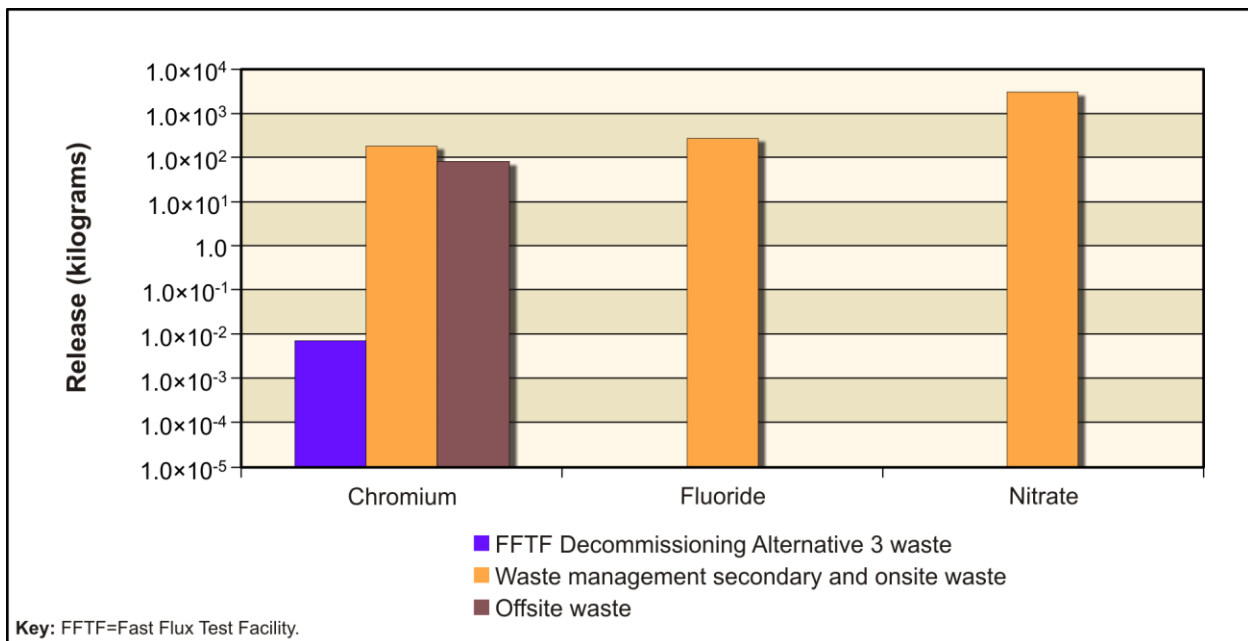


Figure 5-1023. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5-1024 shows the release from IDF-West to groundwater of the radiological risk drivers and Figure 5-1025, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers (iodine-129, technetium-99, chromium, fluoride, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

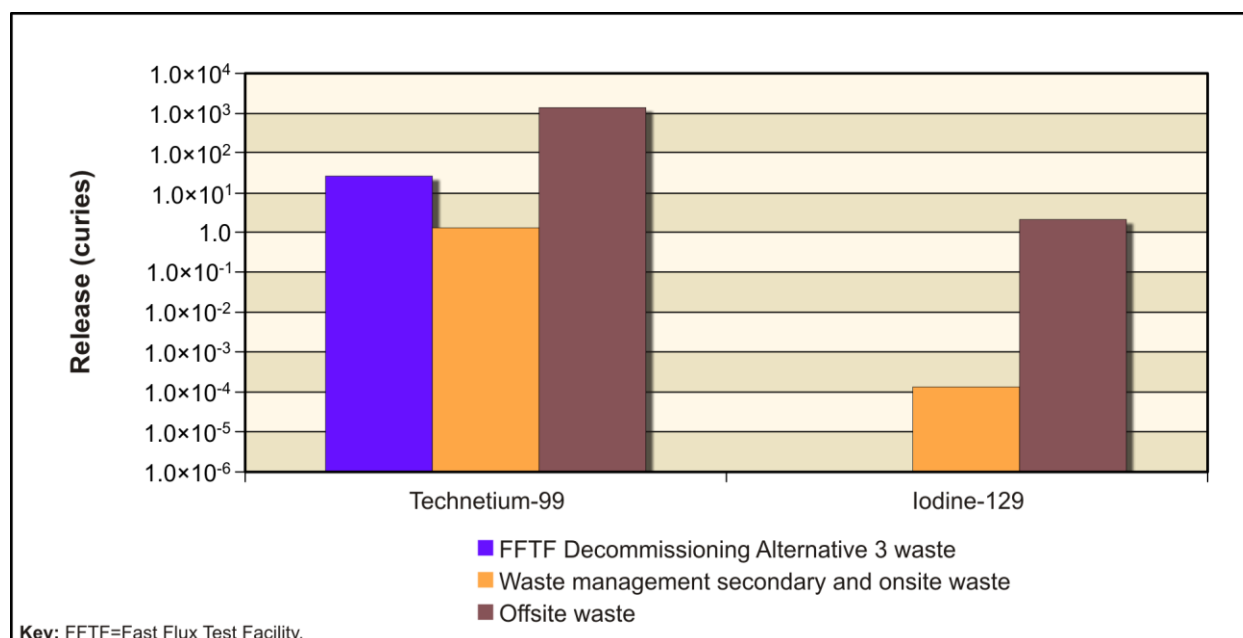


Figure 5–1024. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

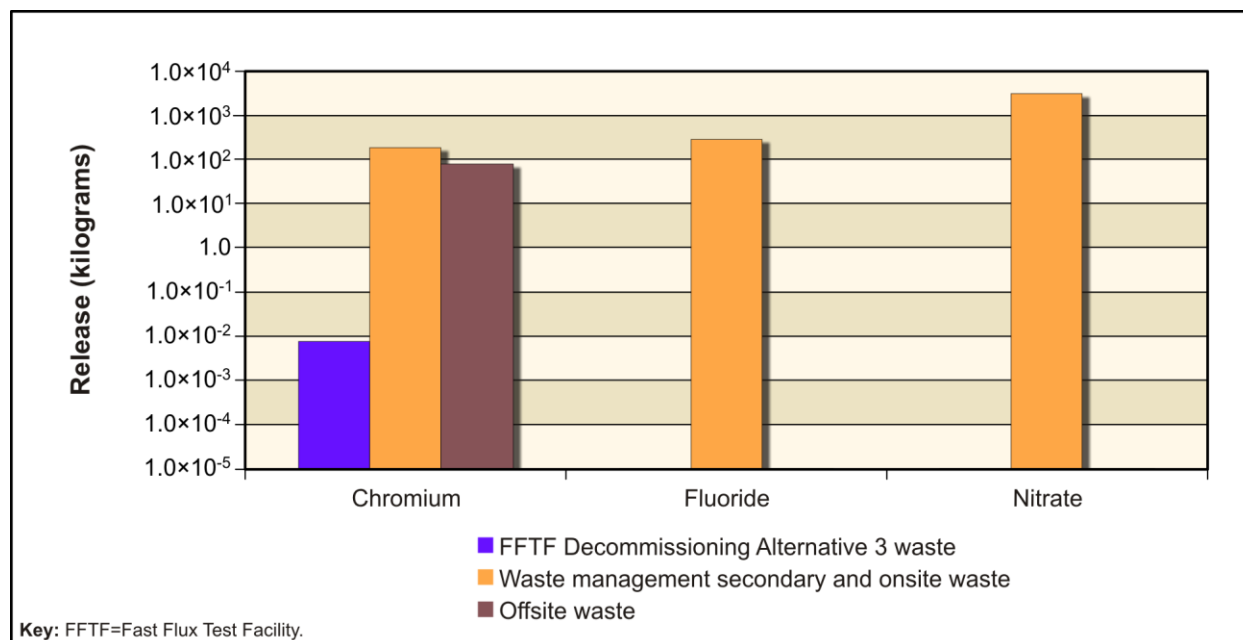


Figure 5–1025. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–1026 shows the release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–1027, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to the Columbia River is approximately 97 to 100 percent of that released to the vadose zone.

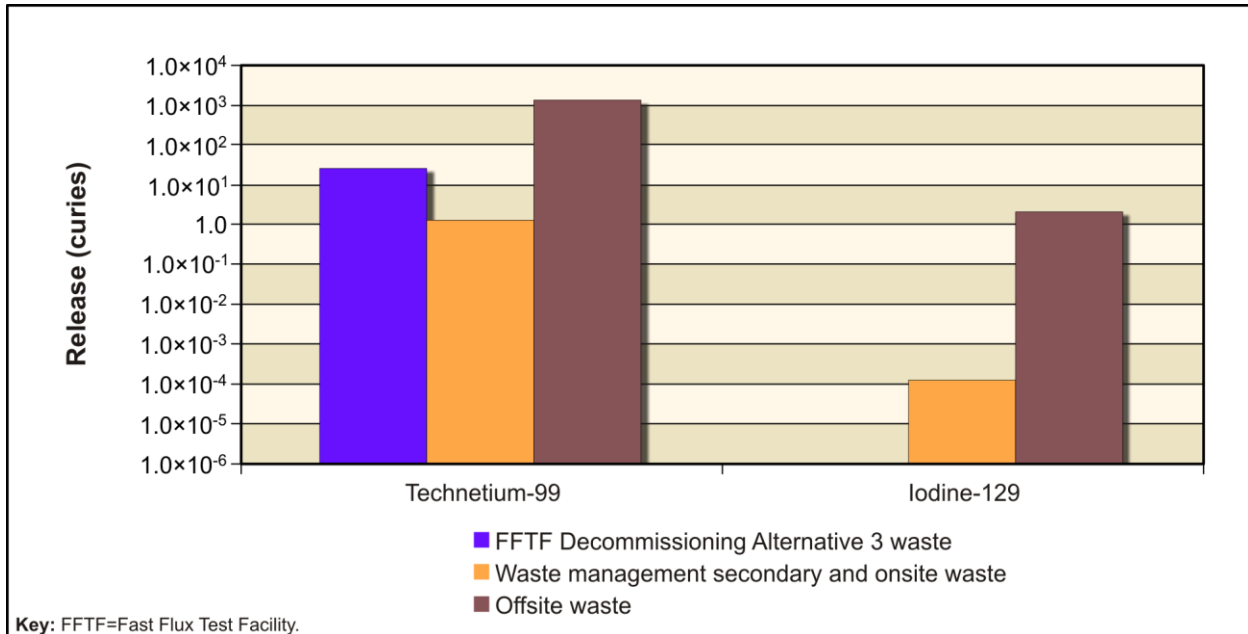


Figure 5-1026. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

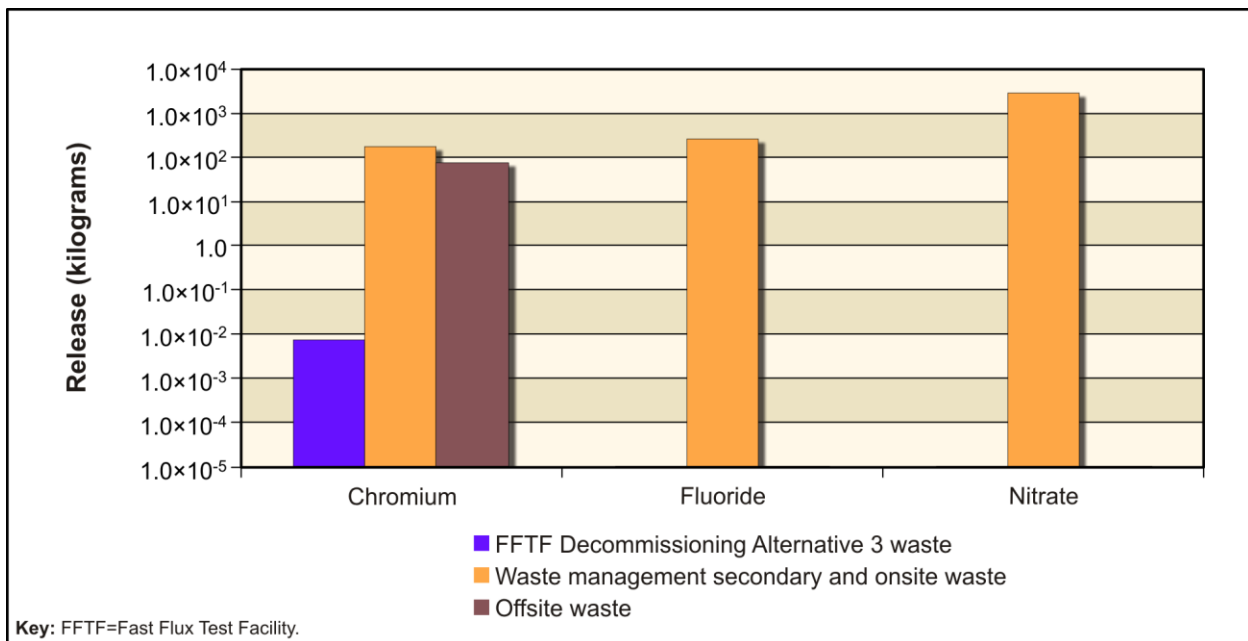


Figure 5-1027. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5-1028 shows the release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5-1029, the chemical hazard drivers. The release of technetium-99 is more than two orders of magnitude greater than the release of iodine-129 from the RPPDF. Of the chemical hazard drivers, nitrate is the predominant COPC; its release is more than two orders of magnitude greater than that of chromium.

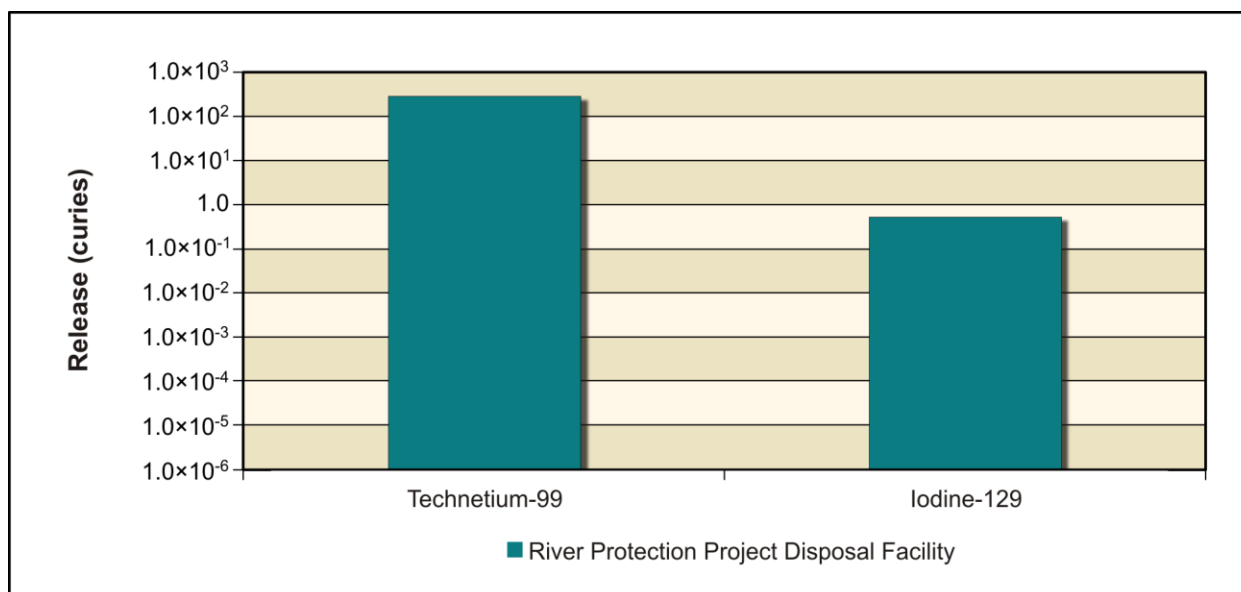


Figure 5–1028. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

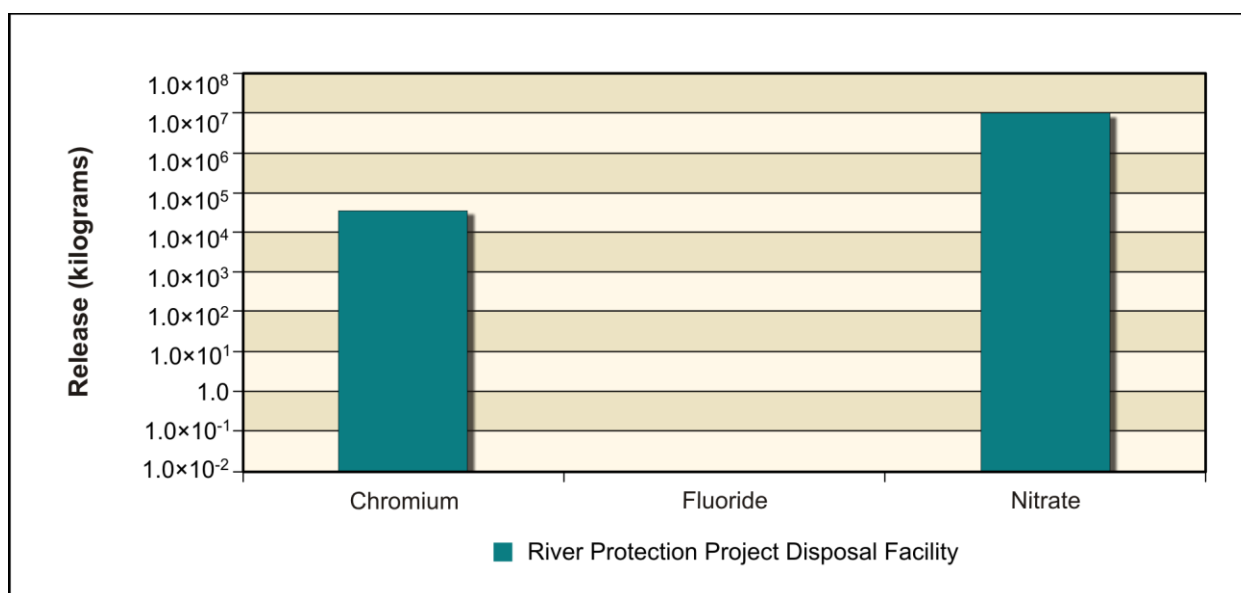


Figure 5–1029. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–1030 shows the release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–1031, the chemical hazard drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

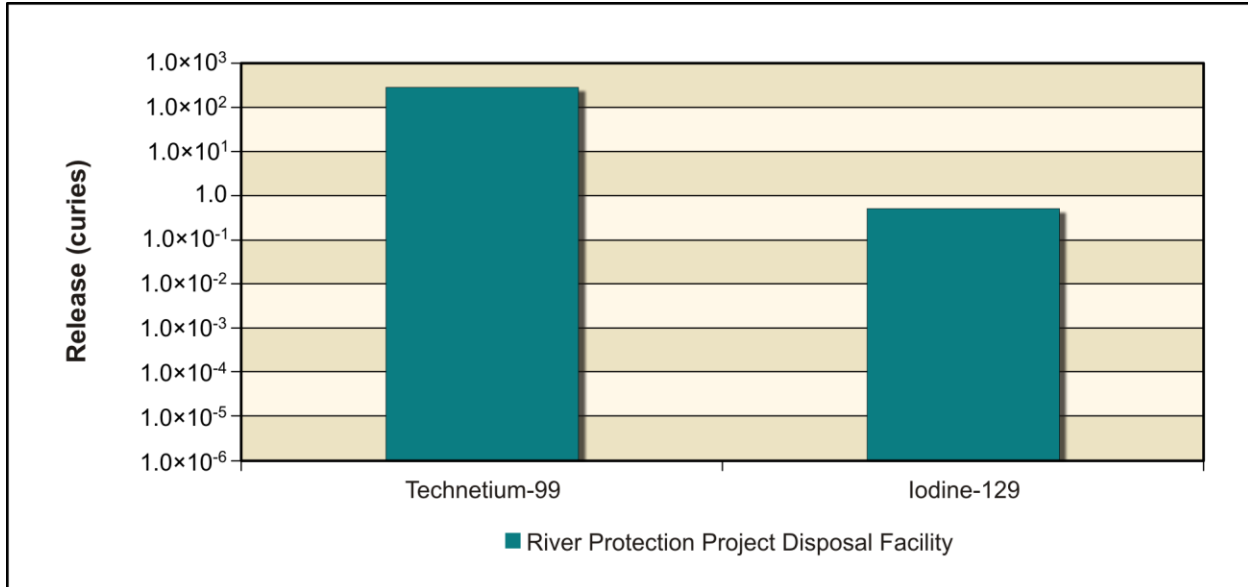


Figure 5–1030. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

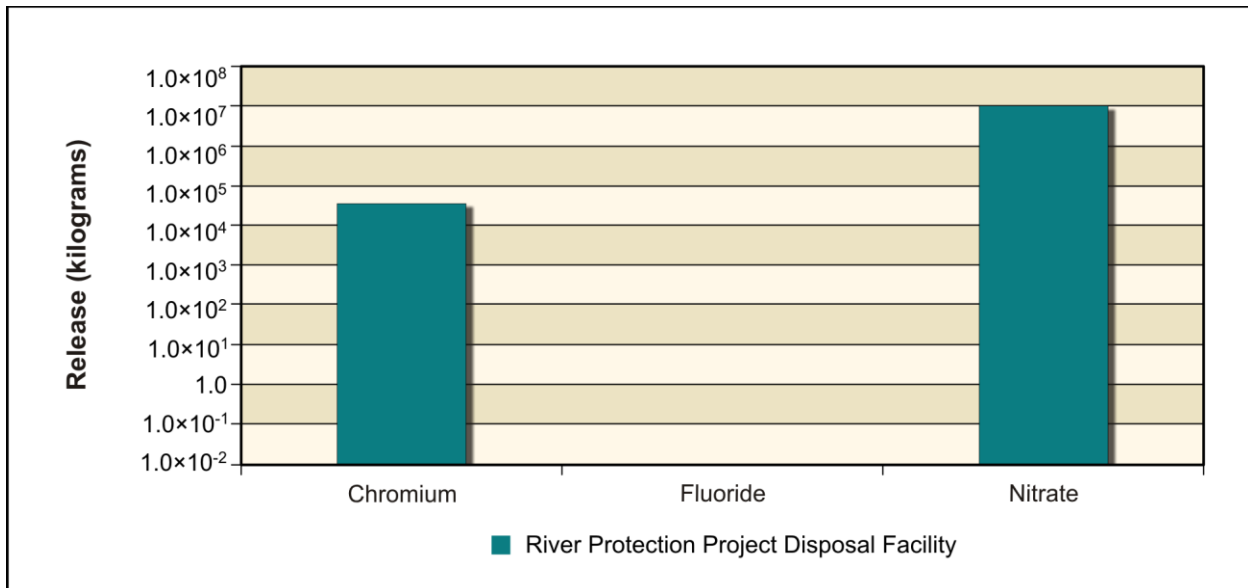


Figure 5–1031. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–1032 shows the release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–1033, the chemical hazard drivers. Essentially all of the inventory of radionuclides and chemicals released to groundwater reach the Columbia River.

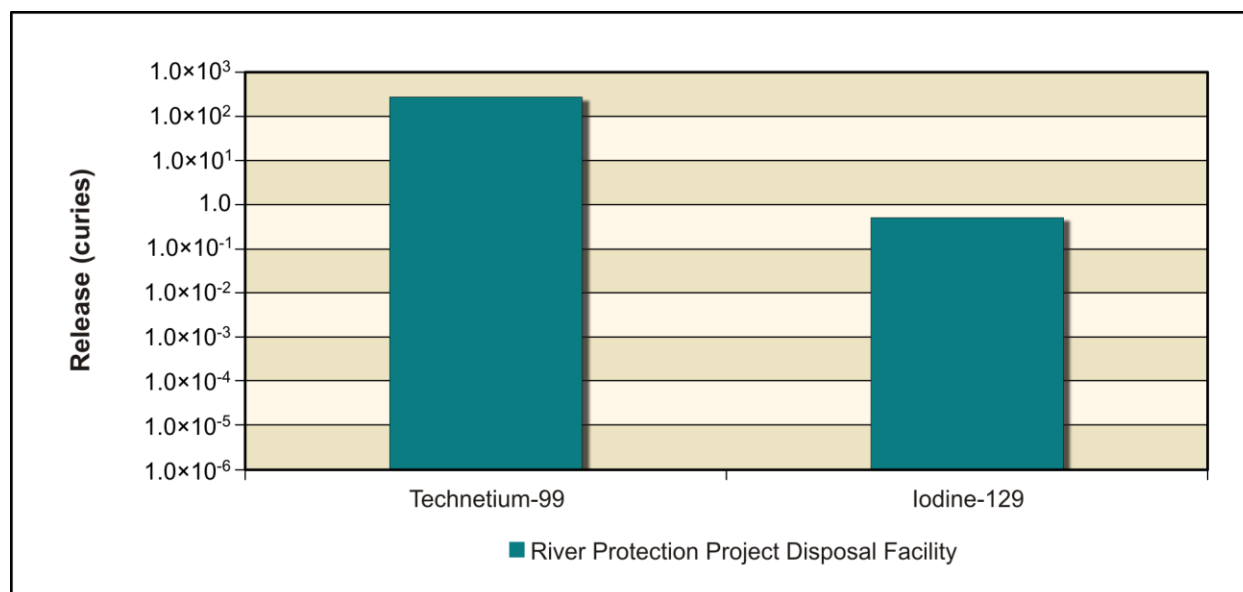


Figure 5–1032. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

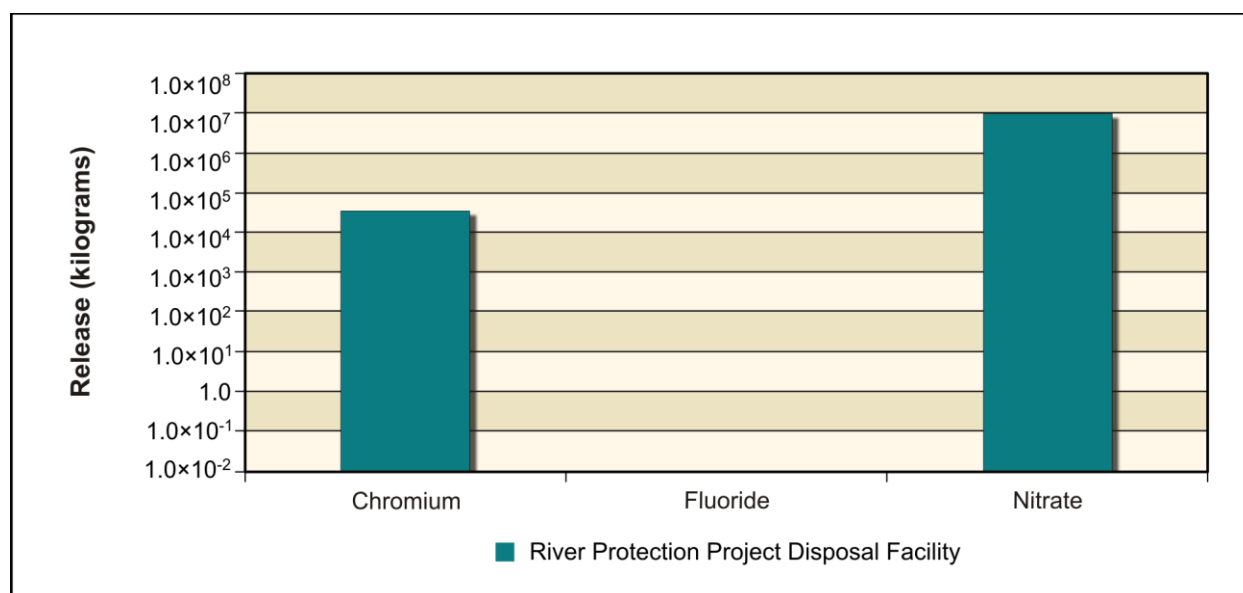


Figure 5–1033. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude.

Figures 5–1034 through 5–1037 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by over an order of magnitude from approximately CY 3200 until CY 4900. Iodine-129 concentrations never exceed the benchmark concentration at the IDF-East barrier or the RPPDF barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by over one order of magnitude. The duration of the benchmark exceedance is approximately 1,500 years. In addition, the technetium-99 benchmark concentration is exceeded at the Columbia River nearshore from approximately CY 3500 to CY 5000. Concentrations at the Core Zone Boundary are exceeded from about CY 3500 to CY 4100. Chromium concentrations peak at less than one order of magnitude below the benchmark at the Core Zone Boundary and RPPDF barrier around CY 4000. Peak nitrate concentrations, less than an order of magnitude below the benchmark, are evident at the RPPDF barrier and IDF-East barrier around CY 3700 and CY 8000, respectively. Nitrate does not exceed benchmark concentrations during the period of analysis.

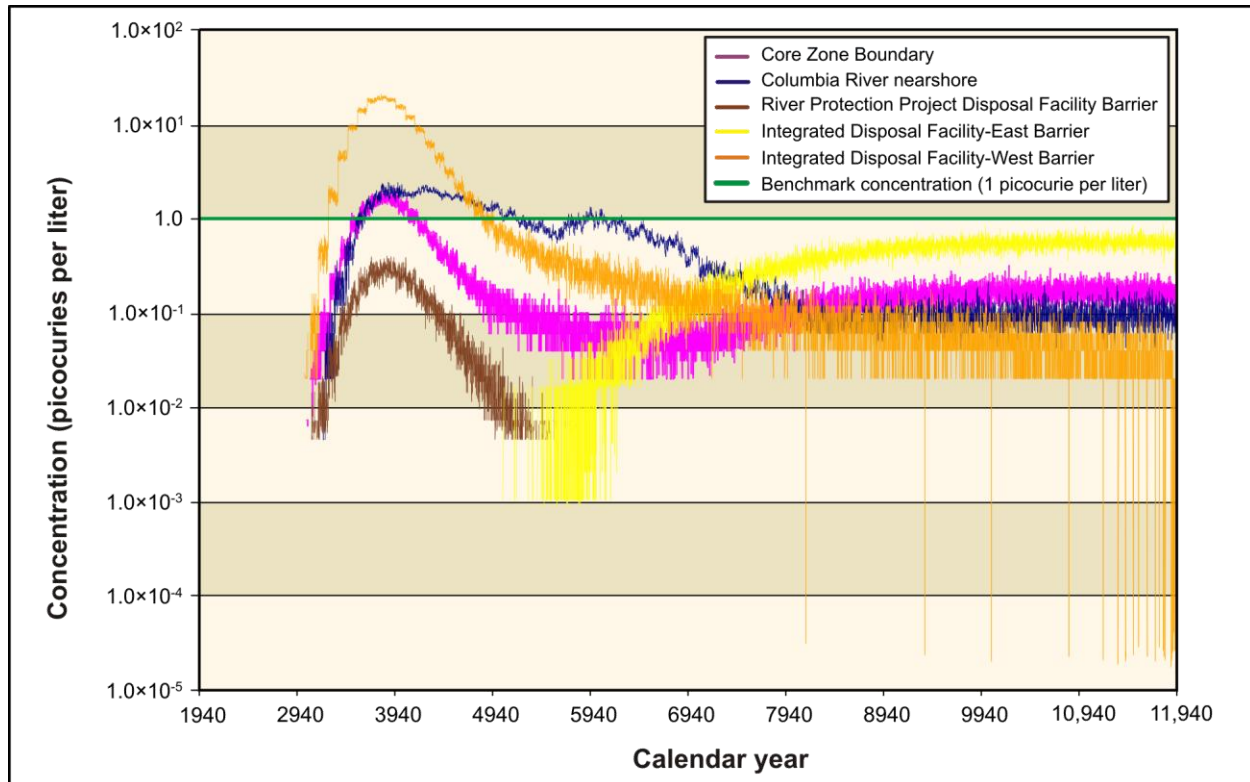


Figure 5–1034. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Iodine-129 Concentration Versus Time

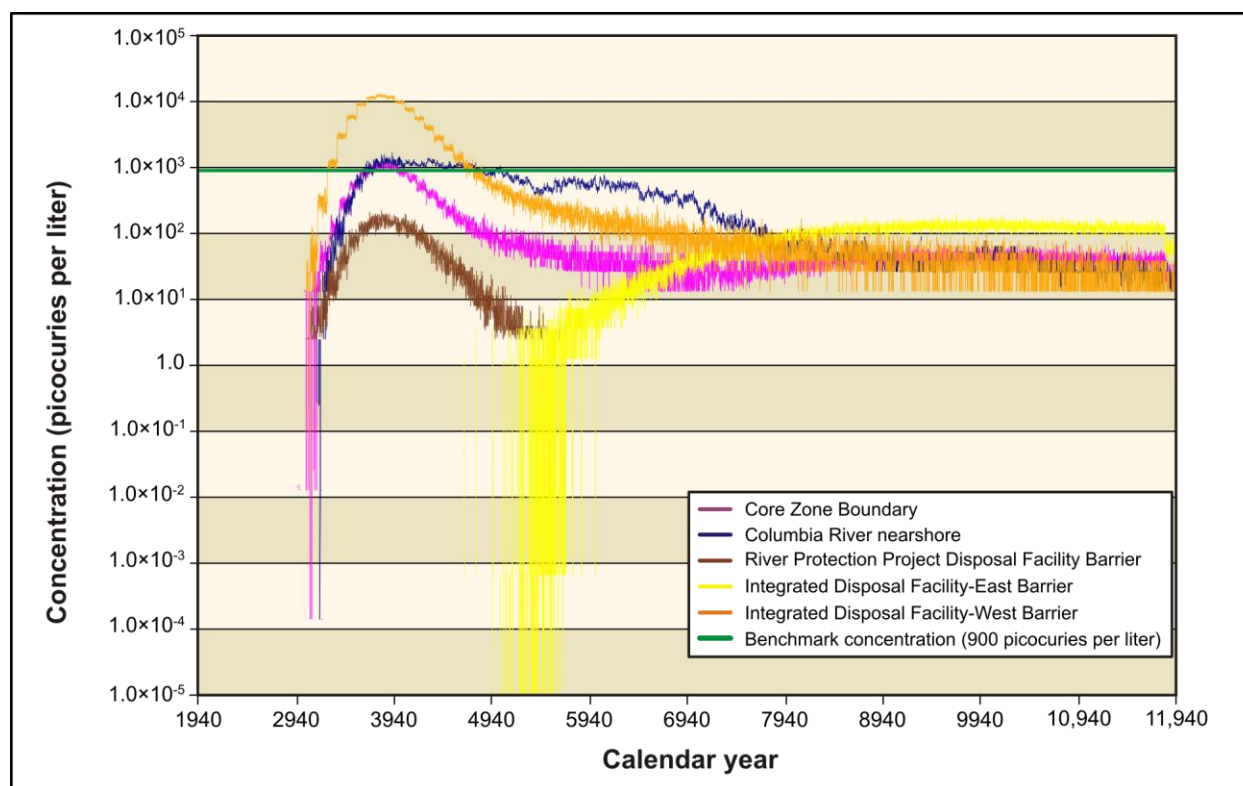


Figure 5–1035. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Technetium-99 Concentration Versus Time

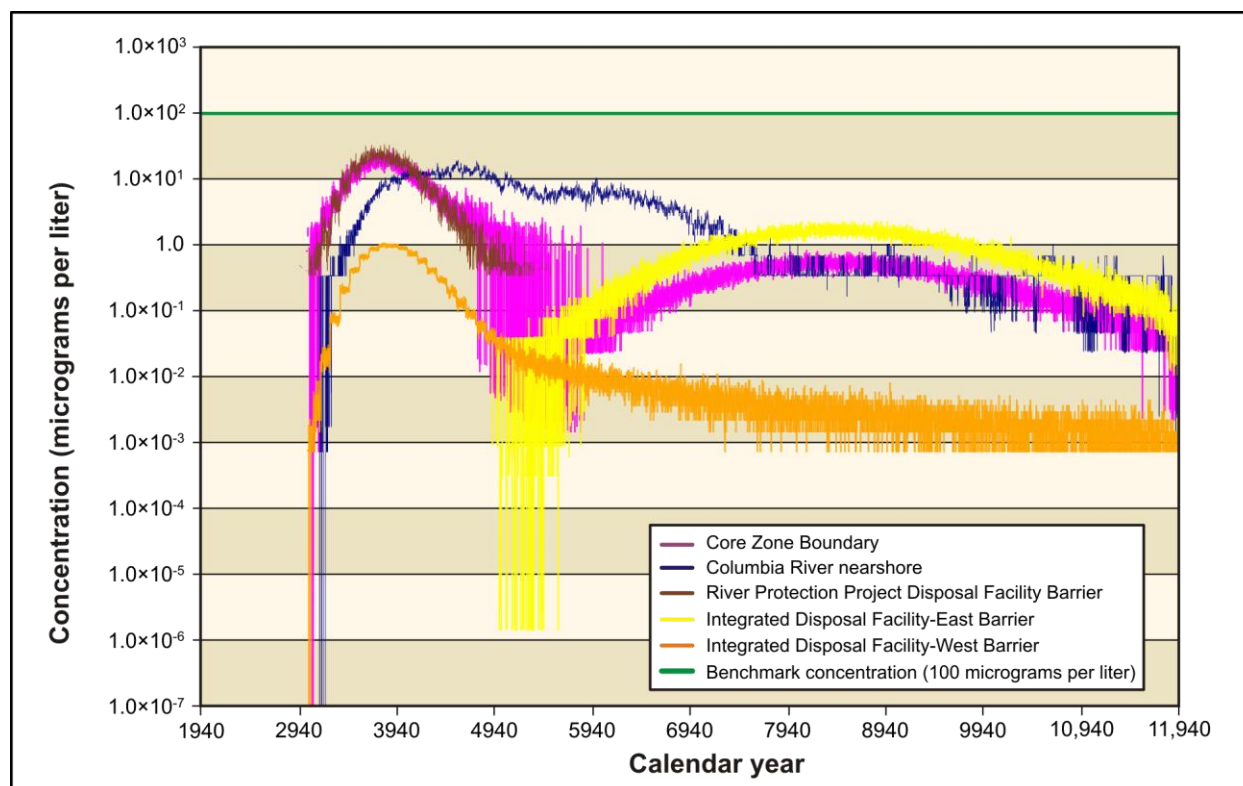


Figure 5–1036. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chromium Concentration Versus Time

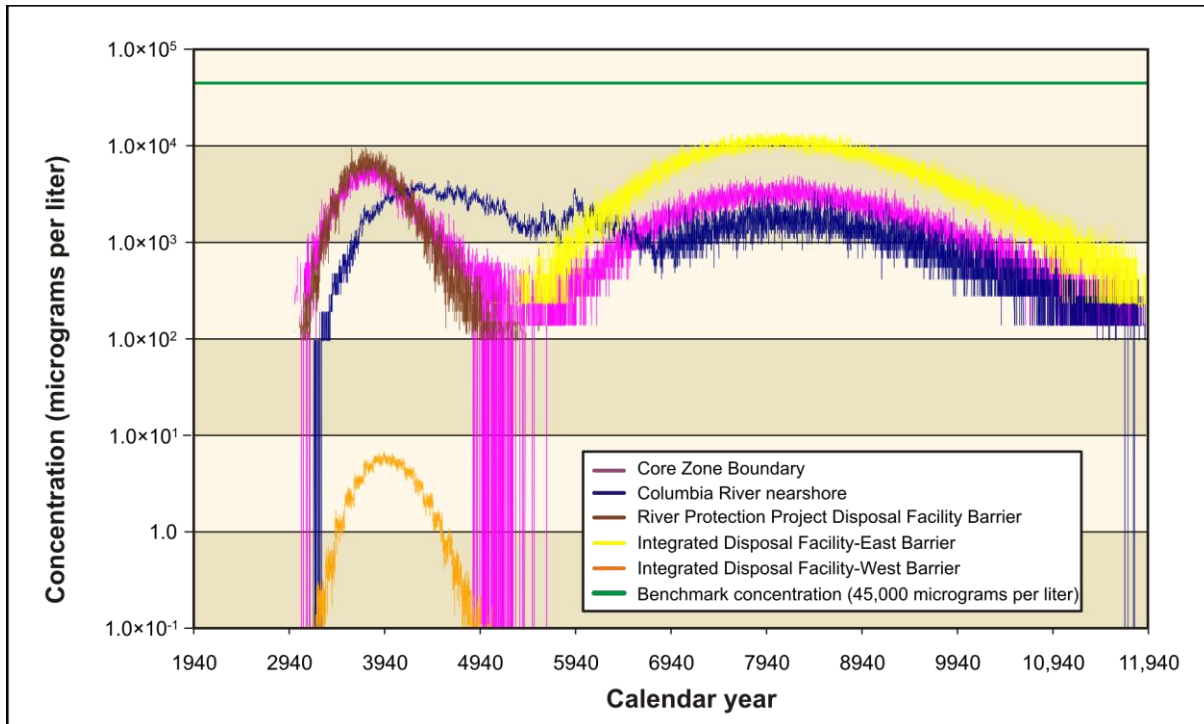


Figure 5-1037. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Nitrate Concentration Versus Time

Table 5-115 shows the maximum concentrations in groundwater. Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, iodine-129 and technetium-99 concentrations both exceed their respective benchmarks at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore around CY 3900. No other constituents exceed their benchmark concentrations under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case.

Table 5-115. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	196	13,200	220	1,370	1,670	900
	(9705)	(3818)	(3812)	(3859)	(3920)	
Iodine-129	0.9	20.6	0.4	2.1	2.4	1
	(11,811)	(3794)	(3858)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	34	29	19	100
	(8152)	(3813)	(3807)	(3901)	(4558)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	14,600	7	9,860	7,220	4,340	45,000
	(7954)	(3927)	(3733)	(3814)	(4606)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in bold text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figure 5–1038 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until roughly CY 7900. Total uranium concentrations rise throughout the remainder of the period of analysis, but remain at least five orders of magnitude lower than the benchmark concentration. Uranium-238 (see Figure 5–1039) also continues to rise after CY 8700, remaining at least six orders of magnitude below the benchmark at the end of the period of analysis.

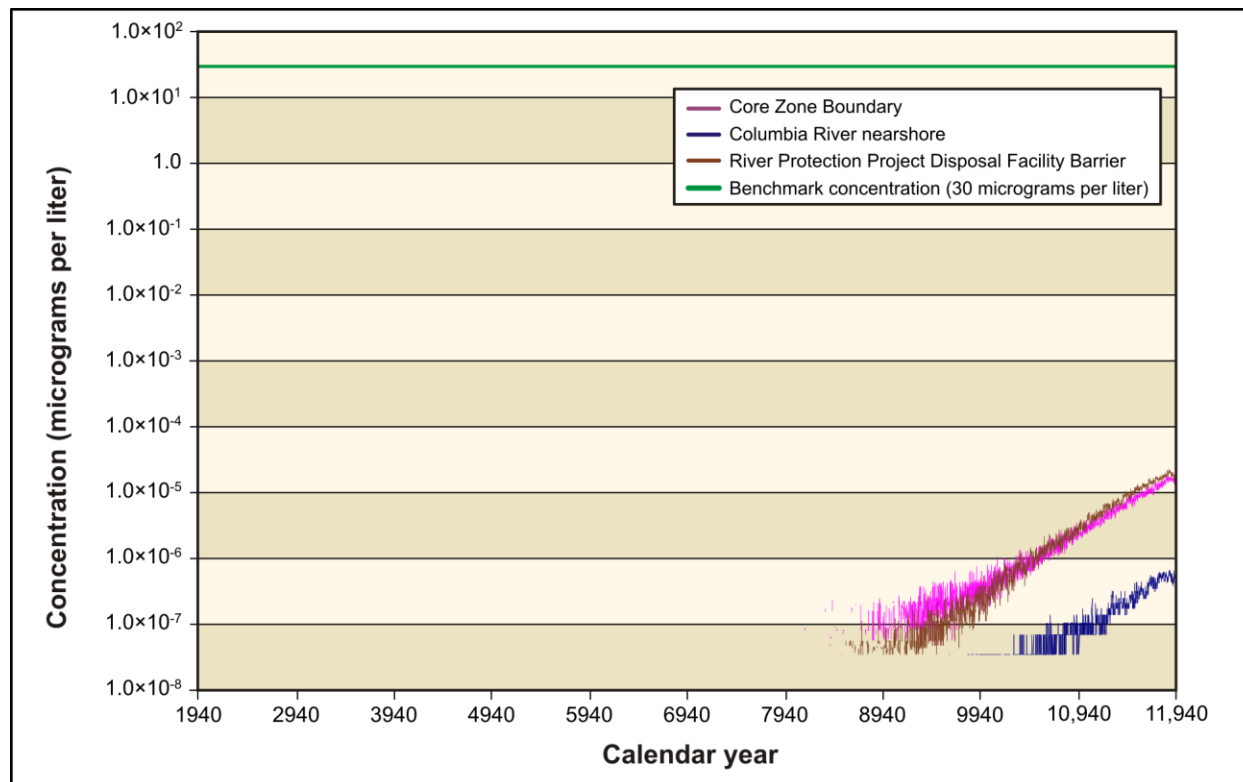
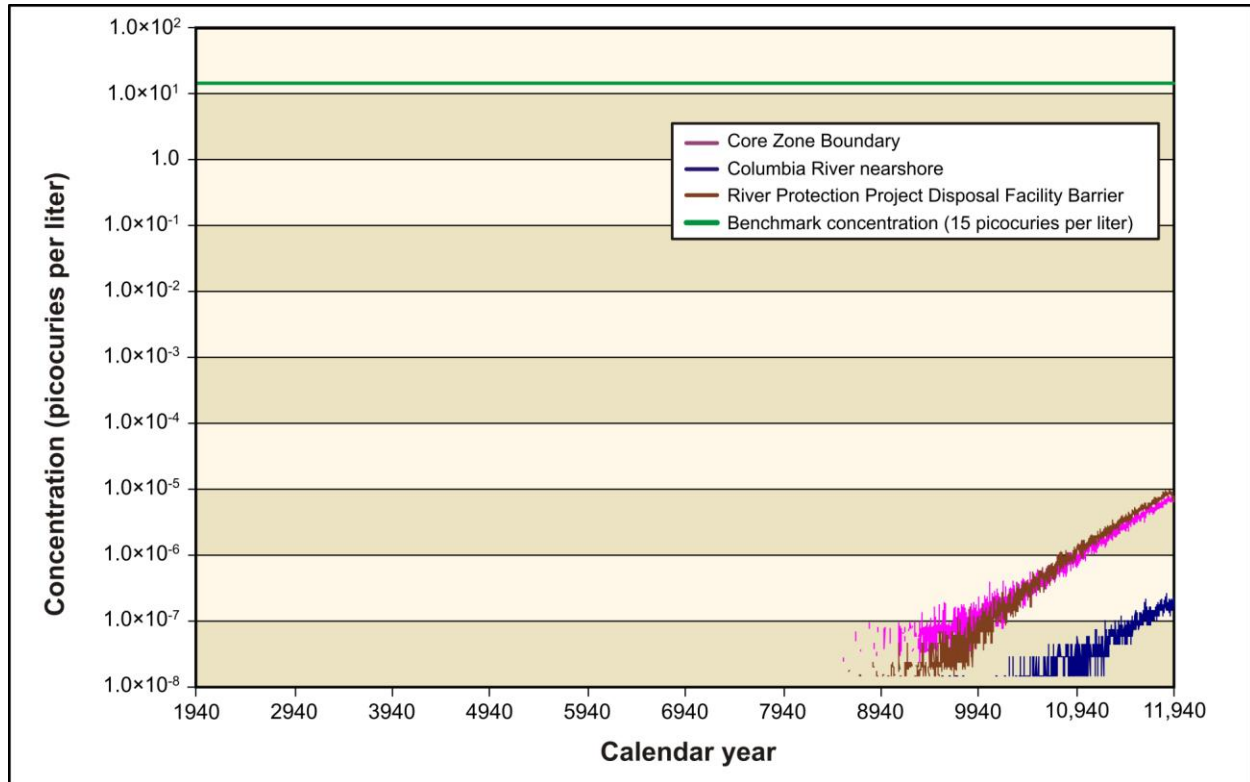


Figure 5–1038. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Total Uranium Concentration Versus Time

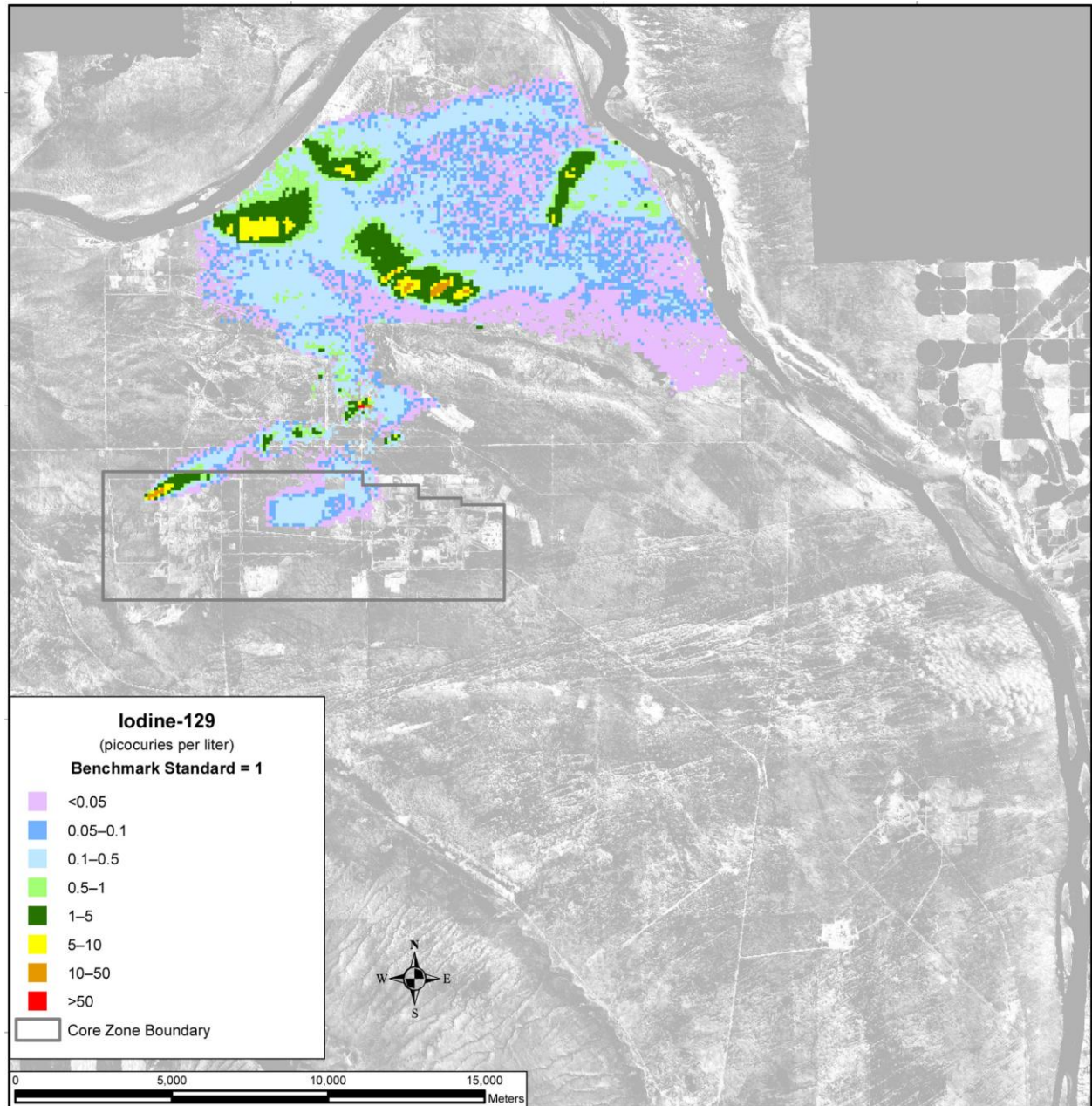


**Figure 5-1039. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B,
Option Case, Uranium-238 Concentration Versus Time**

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figure 5-1040 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890 as a concentrated plume, with peak concentrations 10 to 50 times greater than the benchmark, that stretches north from IDF-West and the RPPDF through Gable Gap. By CY 7140 (see Figure 5-1041), the plume from the RPPDF is reduced, but a new plume is beginning to form, traveling east from IDF-East. The peak concentrations in the second plume are greater than the benchmark. By CY 11,885, the plume continues to spread toward the river and the concentrations continue to increase (see Figure 5-1042). Technetium-99 (see Figures 5-1043 through 5-1045), chromium (see Figures 5-1046 through 5-1048), and nitrate (see Figures 5-1049 through 5-1051) show similar spatial distributions at selected times, but the concentrations remain lower, similar to the later plumes mentioned above. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1040. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890

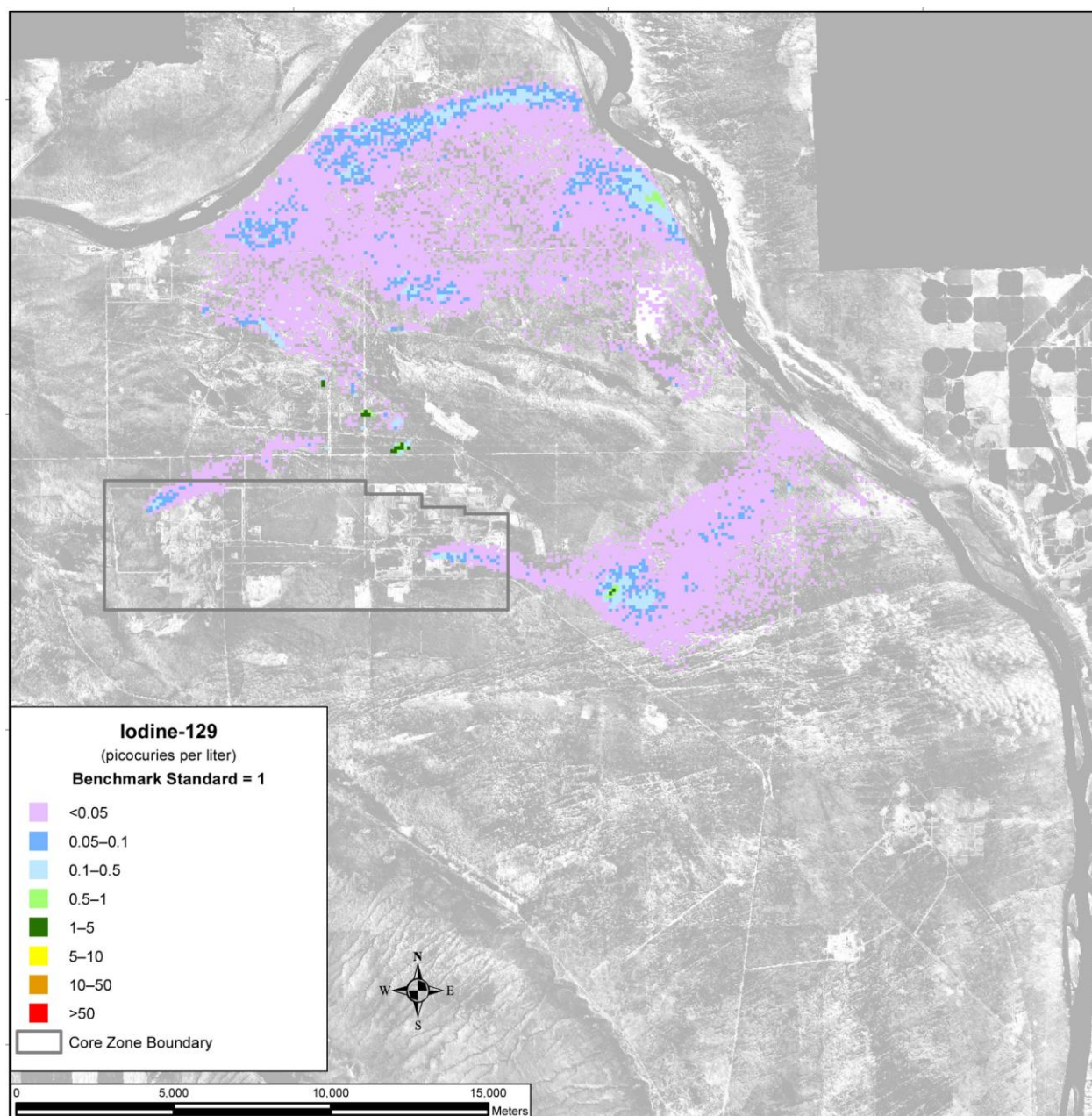
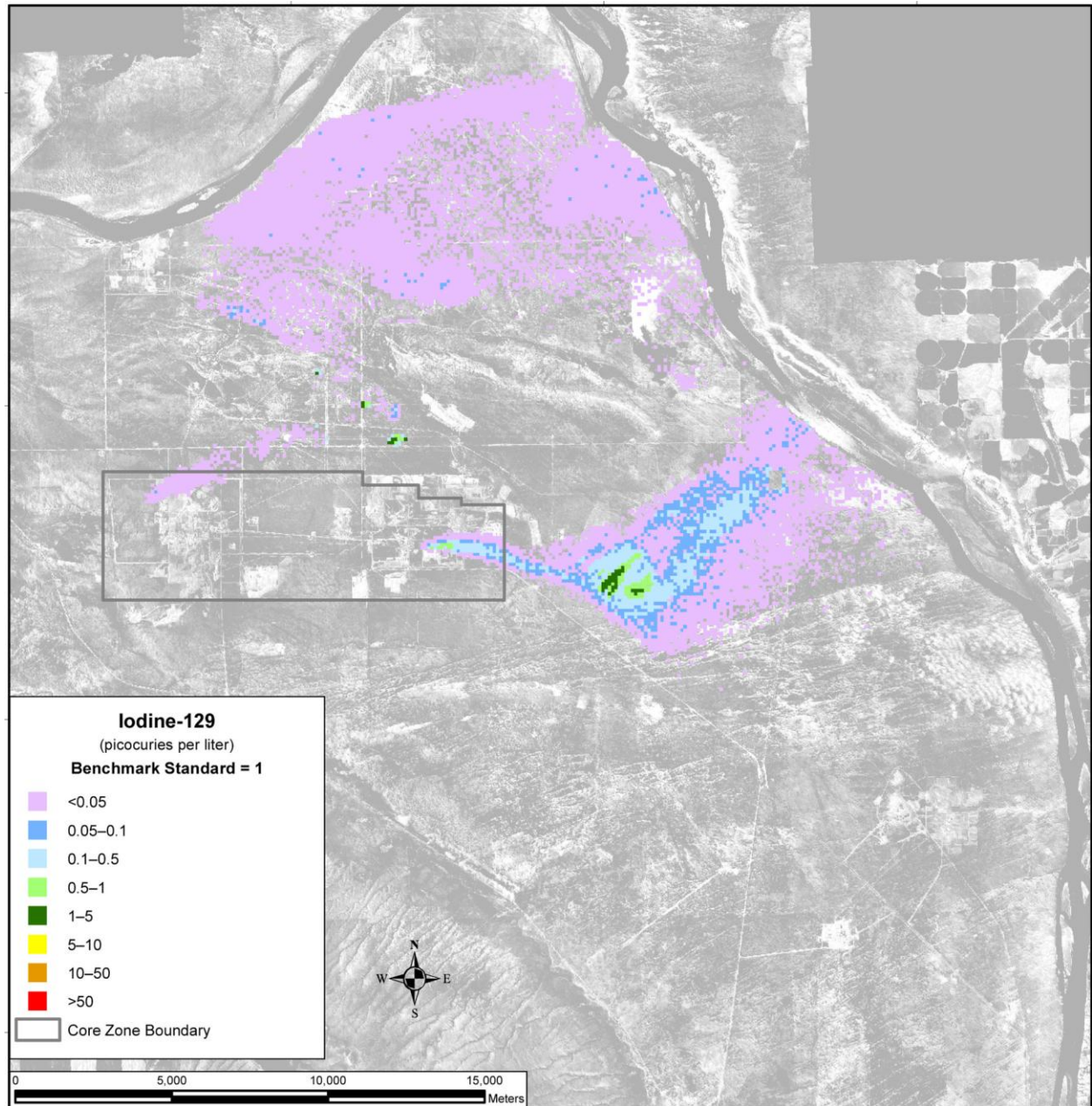


Figure 5–1041. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1042. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885

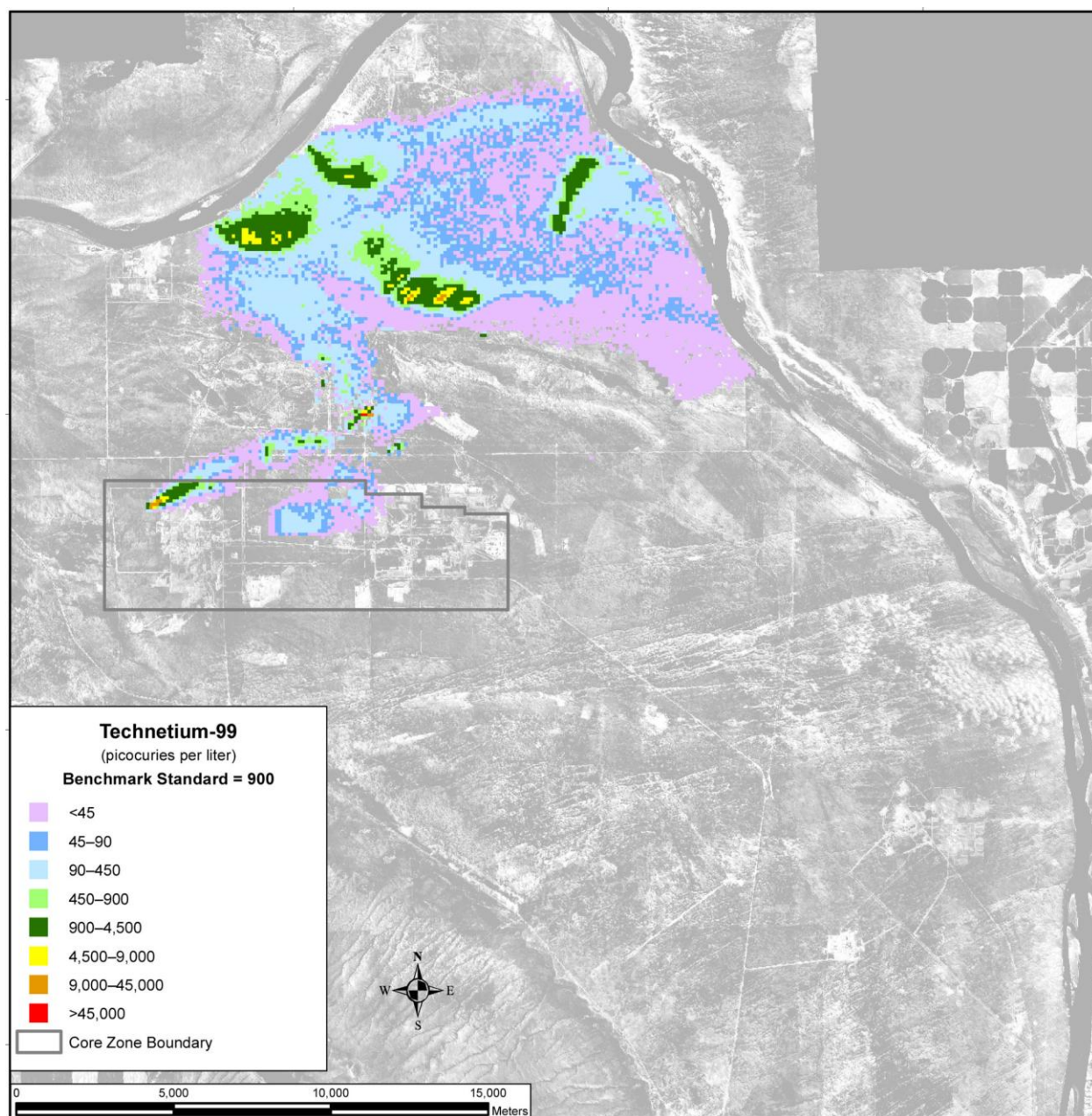
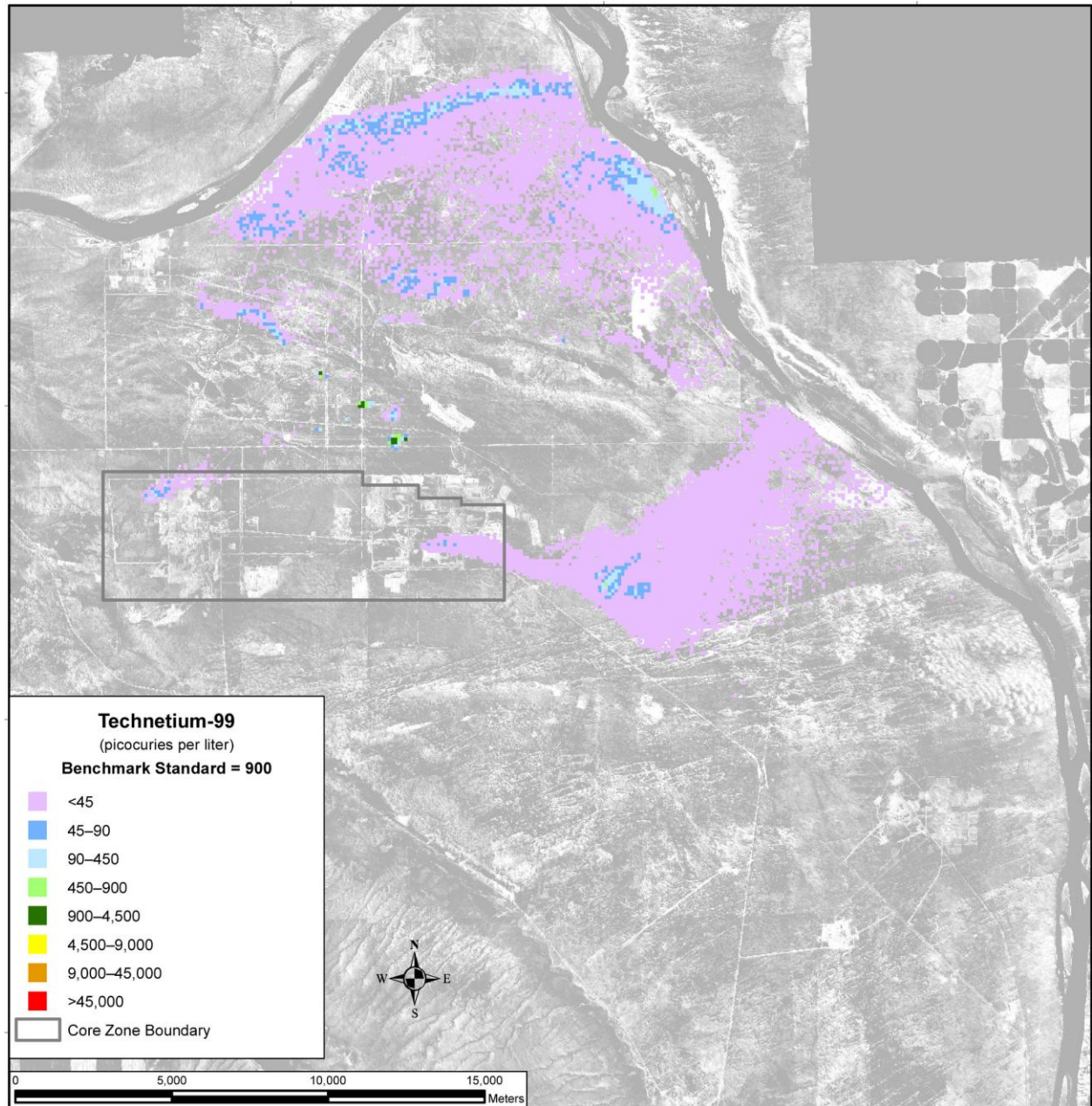


Figure 5-1043. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1044. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140

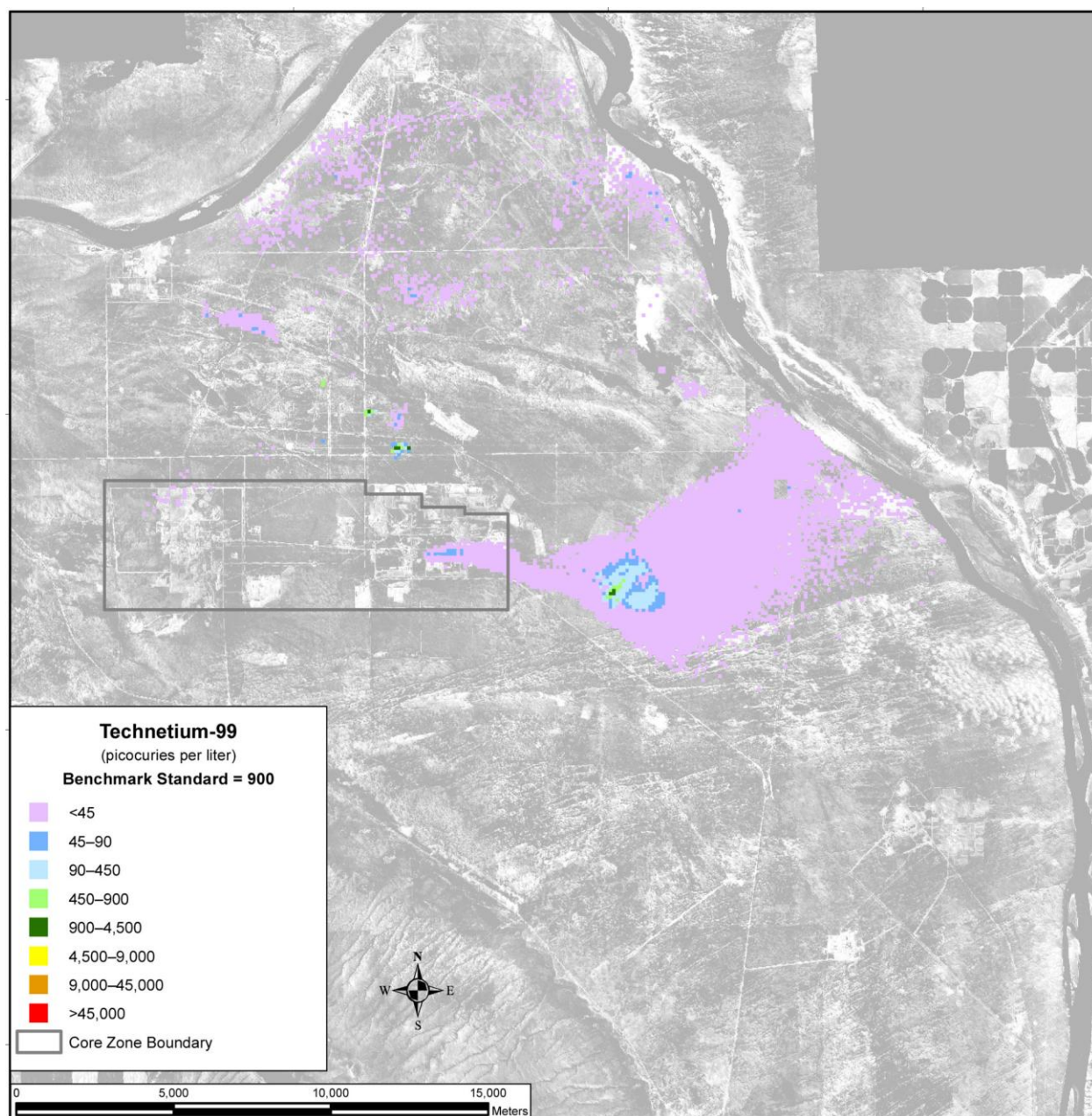
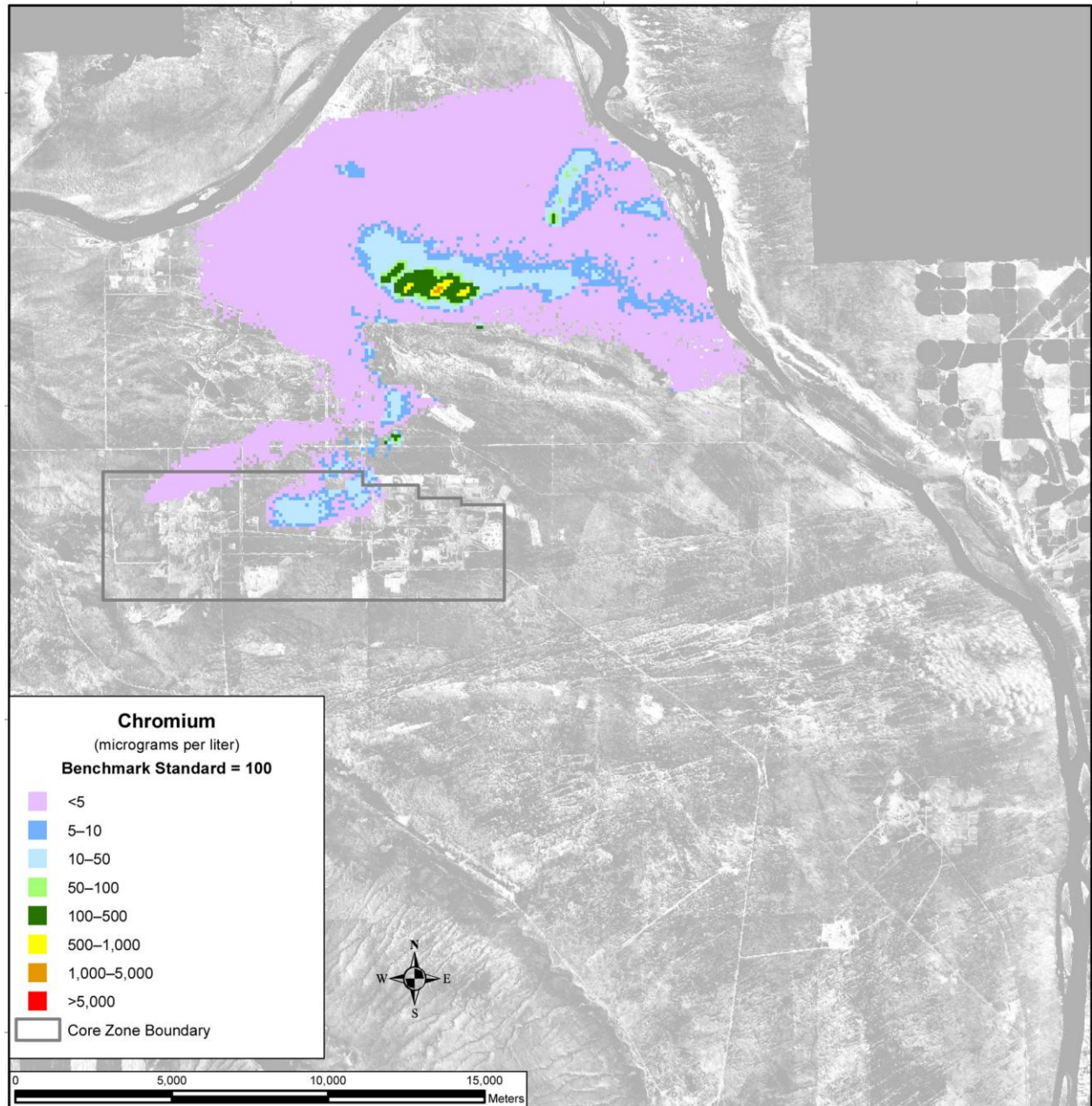
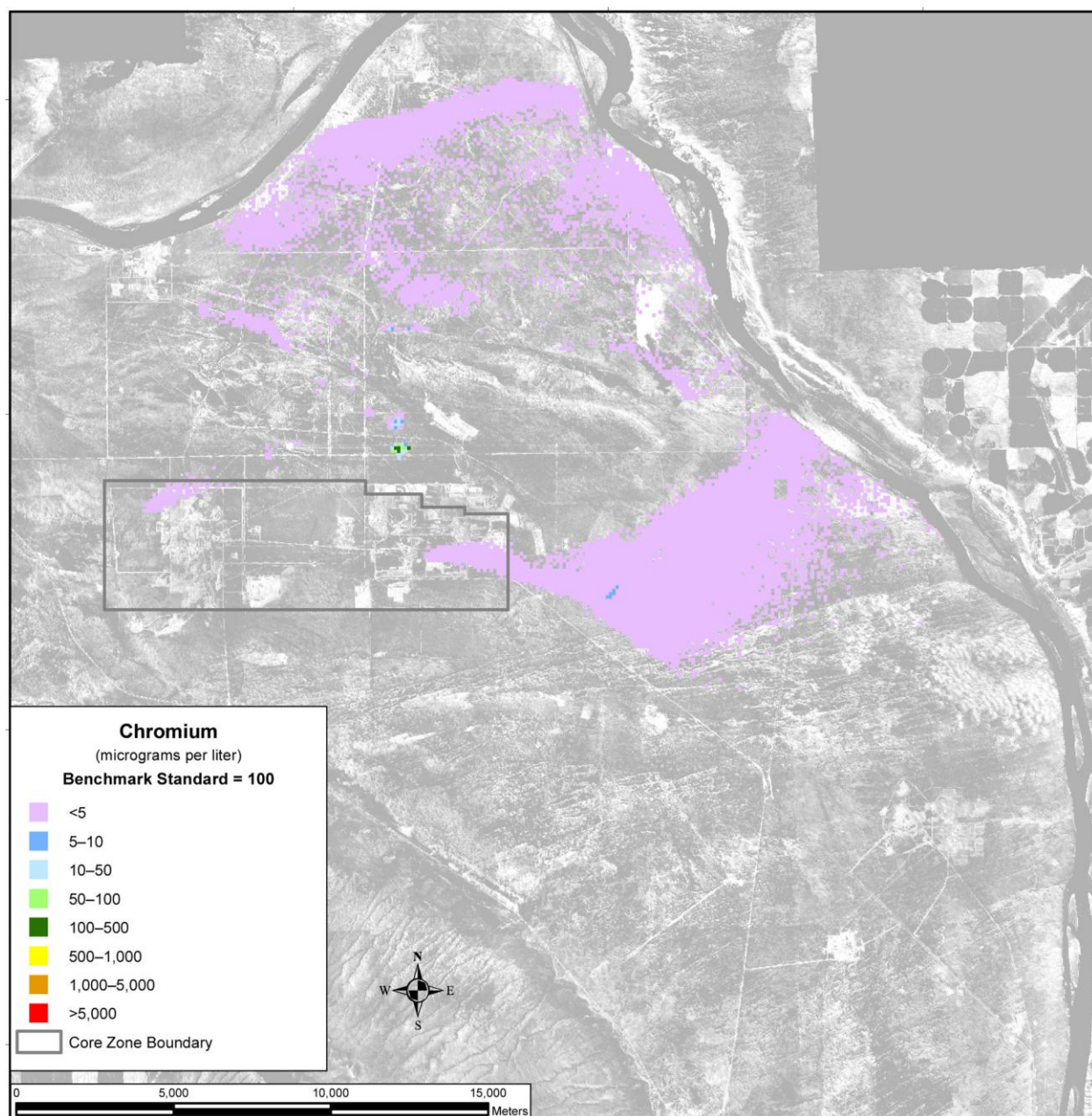


Figure 5-1045. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1046. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1047. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140

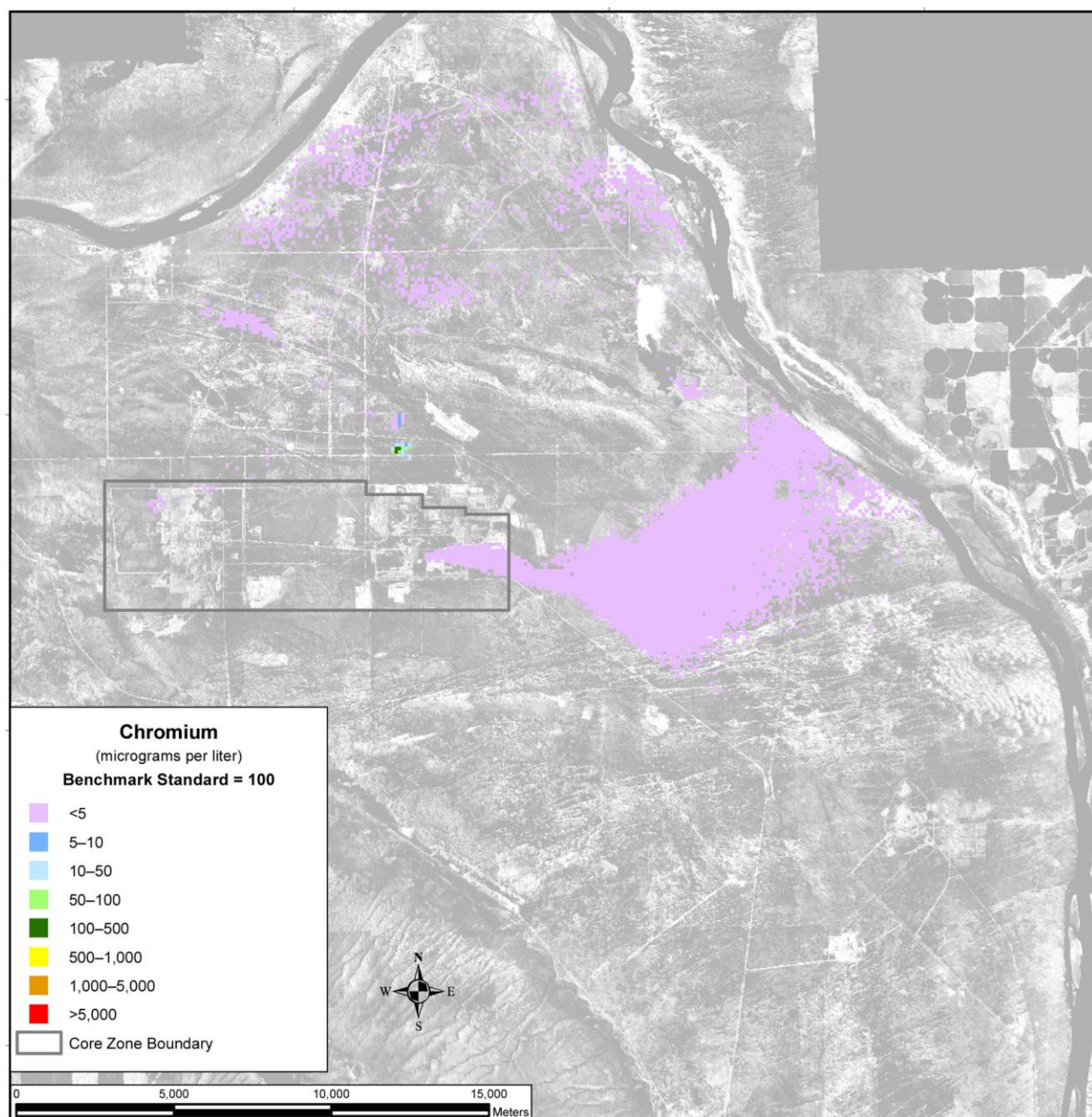


Figure 5–1048. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

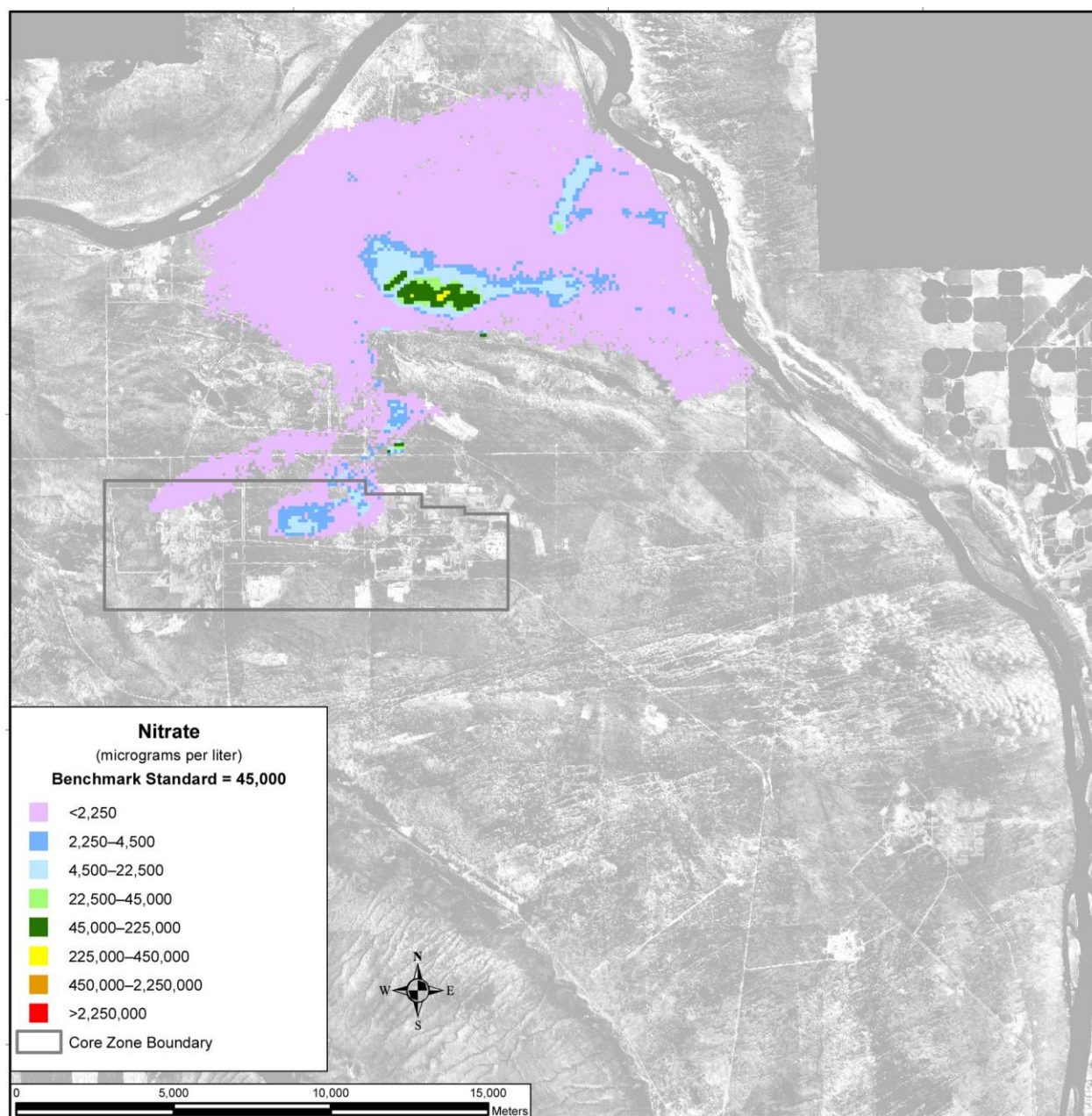
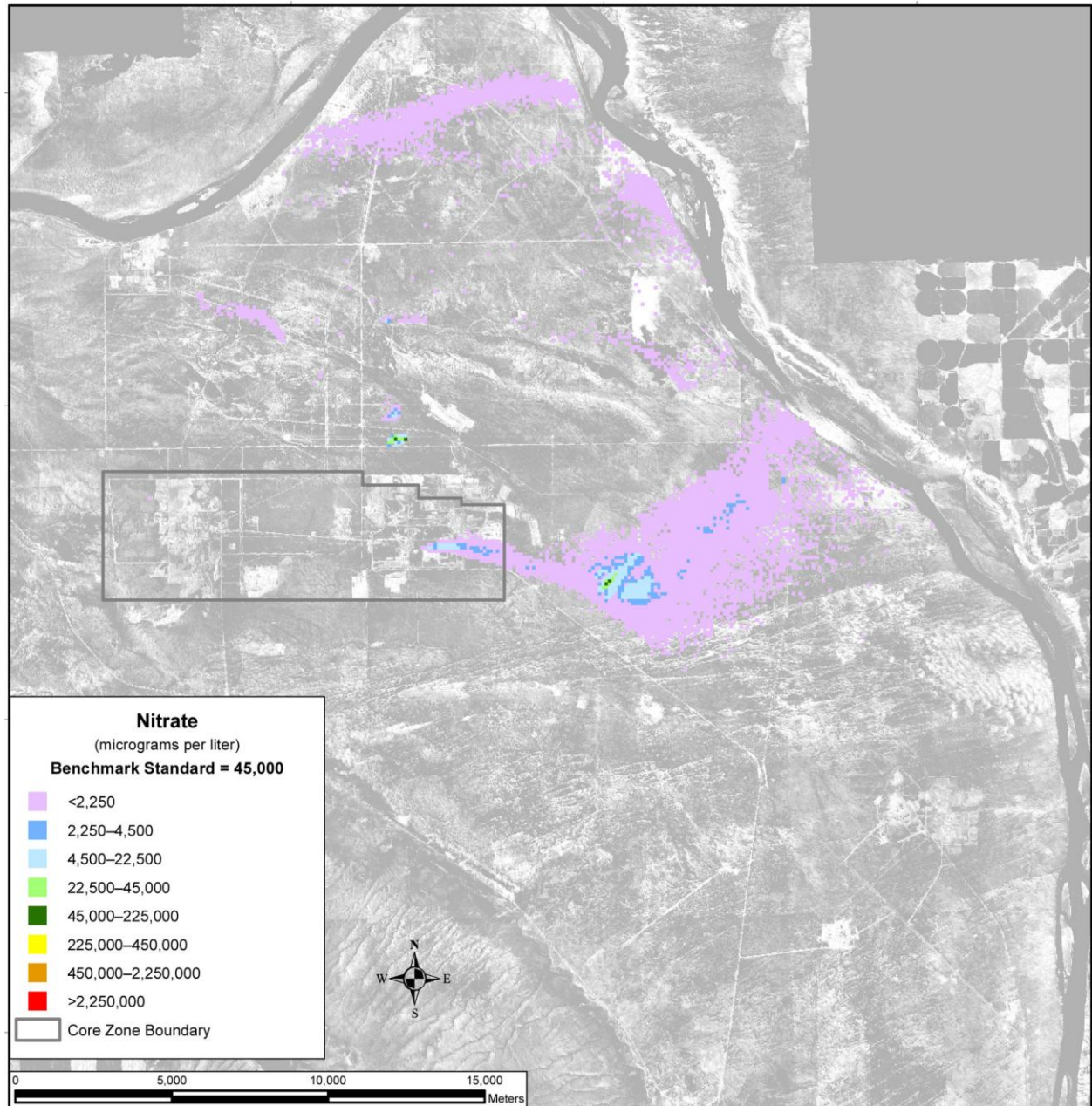
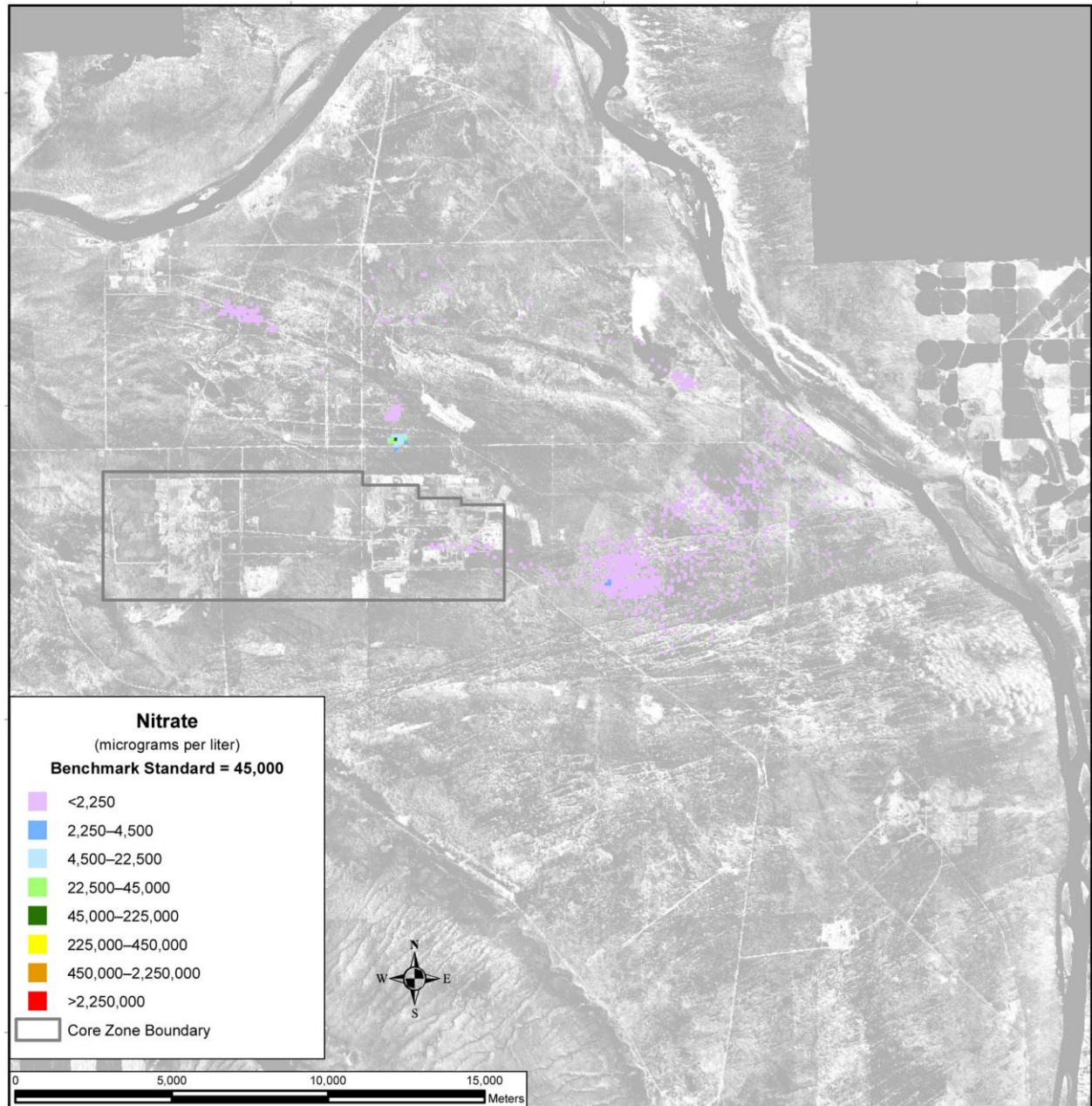


Figure 5–1049. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

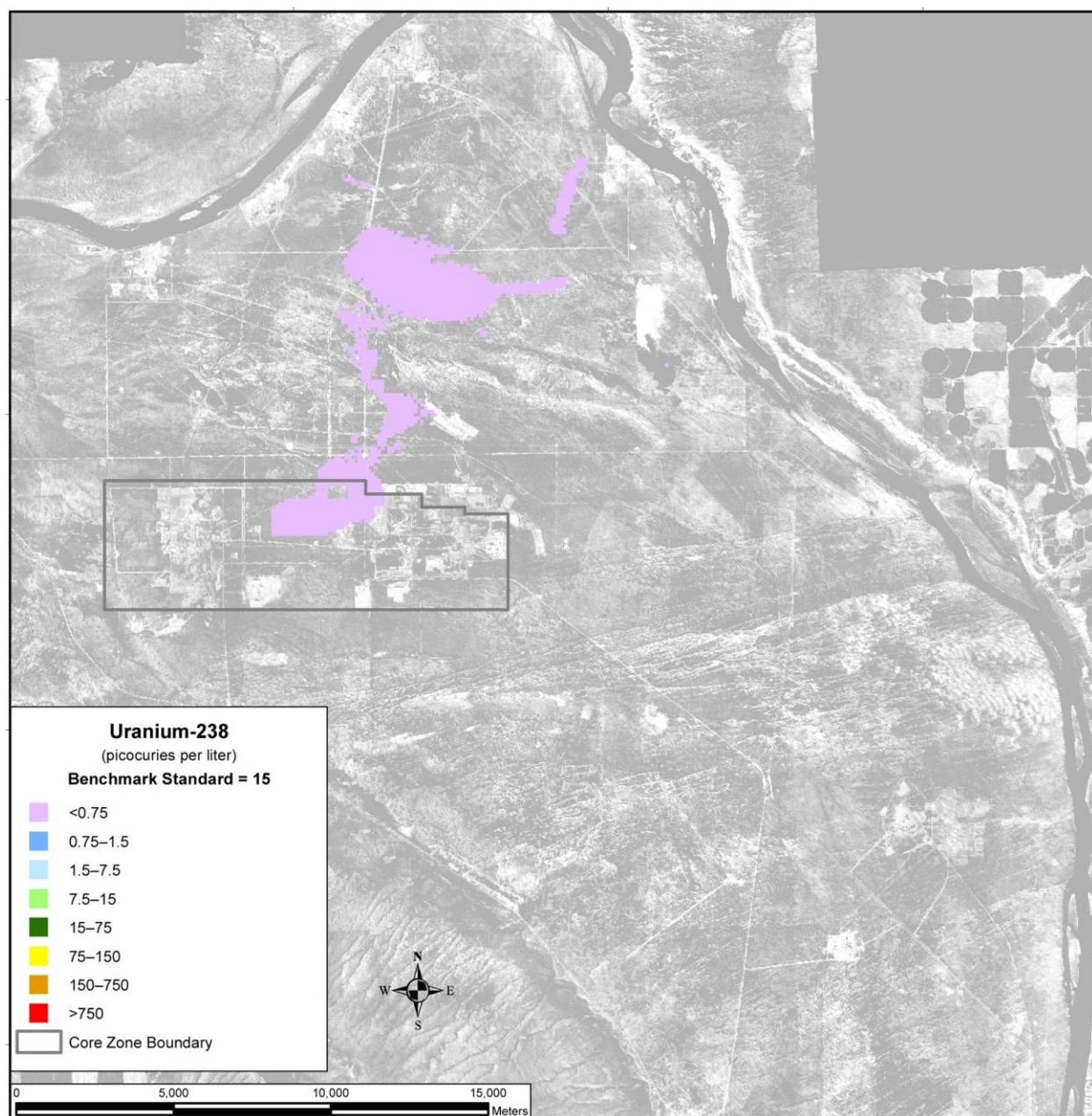
Figure 5–1050. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1051. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

Uranium COPCs show a different spatial distribution over time. These COPCs are not as mobile as those discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–1052 shows the distribution of uranium-238 in CY 11,885. Figure 5–1053 shows the distribution of total uranium in CY 11,885. Both uranium-238 and total uranium show low-concentration plumes that stretch north from IDF-West and the RPPDF through Gable Gap. Concentrations in all areas of the plume remain below one-twentieth of the benchmark.



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1052. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Uranium-238 Concentration, Calendar Year 11,885

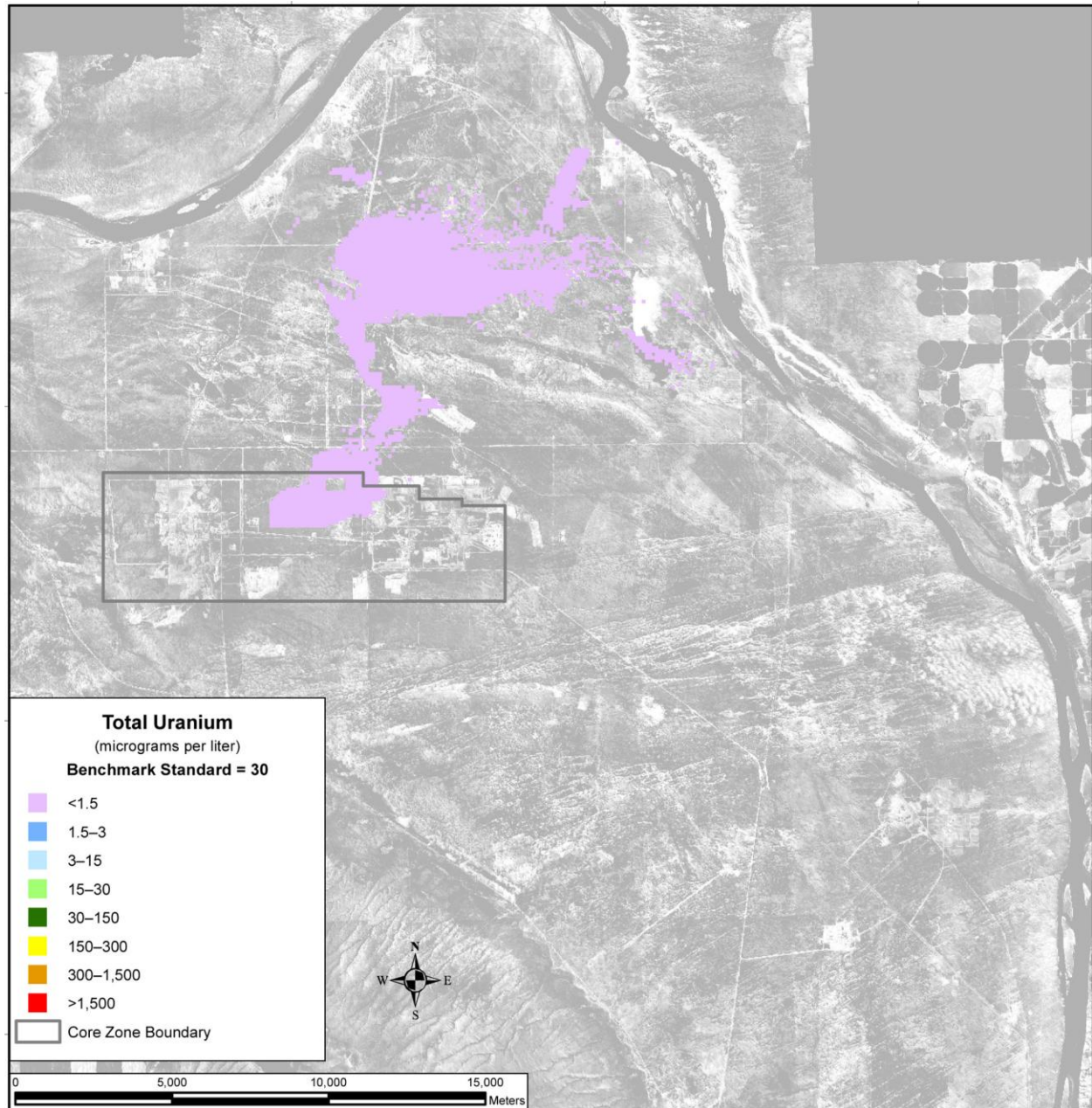


Figure 5–1053. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in general, the inventories remaining in IDF-East and IDF-West, which are available for release to the environment at the start of the post-disposal period, are predominant contributors. The increased inventory available for release from the RPPDF during the post-disposal period is a secondary contributor.

For the conservative tracers, only concentrations of technetium-99 and iodine-129 exceed their benchmarks at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Both constituents exceed the benchmark standards by over one order of magnitude at the IDF-West barrier and

by less than one order of magnitude at the Core Zone Boundary and Columbia River nearshore around CY 3900.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of this retarded species do not exceed the benchmark at the Core Zone Boundary or the Columbia River nearshore by CY 10,000. The intensity is highest and the area of the contamination plume largest near the end of the period of analysis.

5.3.1.3.3 Disposal Group 3

Disposal Group 3 is characterized by operational completion dates of CY 2165 for IDF-East and the RPPDF and CY 2050 for IDF-West. Under Disposal Group 3, IDF-West would have a large capacity (90,000 cubic meters [117,720 cubic yards]); IDF-East, a larger capacity (340,000 cubic meters [425,100 cubic yards]); and the RPPDF, an even larger capacity (8,330,000 cubic meters [10,947,960 cubic yards]). These capacities were designed to meet the waste generation volumes associated with Tank Closure Alternative 6A, Base or Option Case, and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

5.3.1.3.3.1 Disposal Group 3, Base Case

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 3, Base Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6A, Base Case, and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 3, Base Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2165, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.
- The post-disposal period was assumed to start in CY 2166 and continue through the 10,000-year period of analysis. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 3, Base Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 3, Base Case, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, nitrate, and fluoride

The COPC drivers for Waste Management Alternative 3, Disposal Group 3, Base Case, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the

Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 3, Base Case.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, nitrate, and fluoride) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Base Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Four subtotals are plotted in Figures 5–1054 through 5–1059, representing releases from IDF-East, which include ETF-generated secondary waste, PPF glass, retired melters, and tank closure secondary waste.

Figure 5–1054 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–1055, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., all of the inventory is released during the post-disposal period). The predominant source of technetium-99 and chromium is tank closure secondary waste. The predominant source of iodine-129 and nitrate is ETF-generated secondary waste. Fluoride is not released from IDF-East.

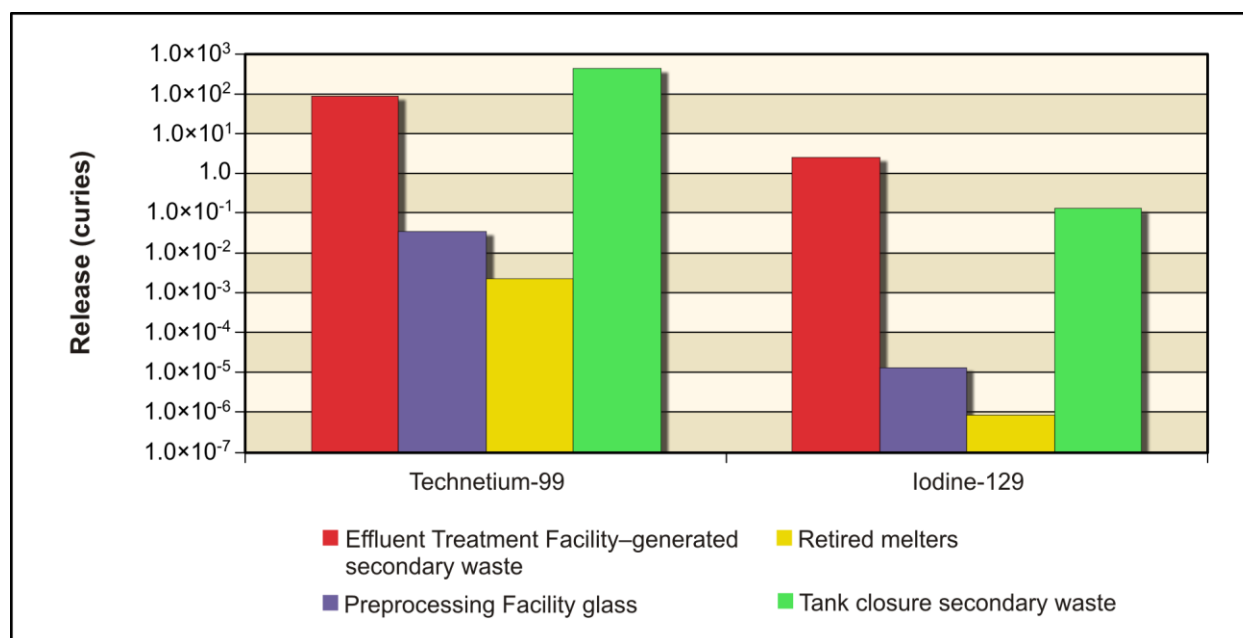


Figure 5-1054. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

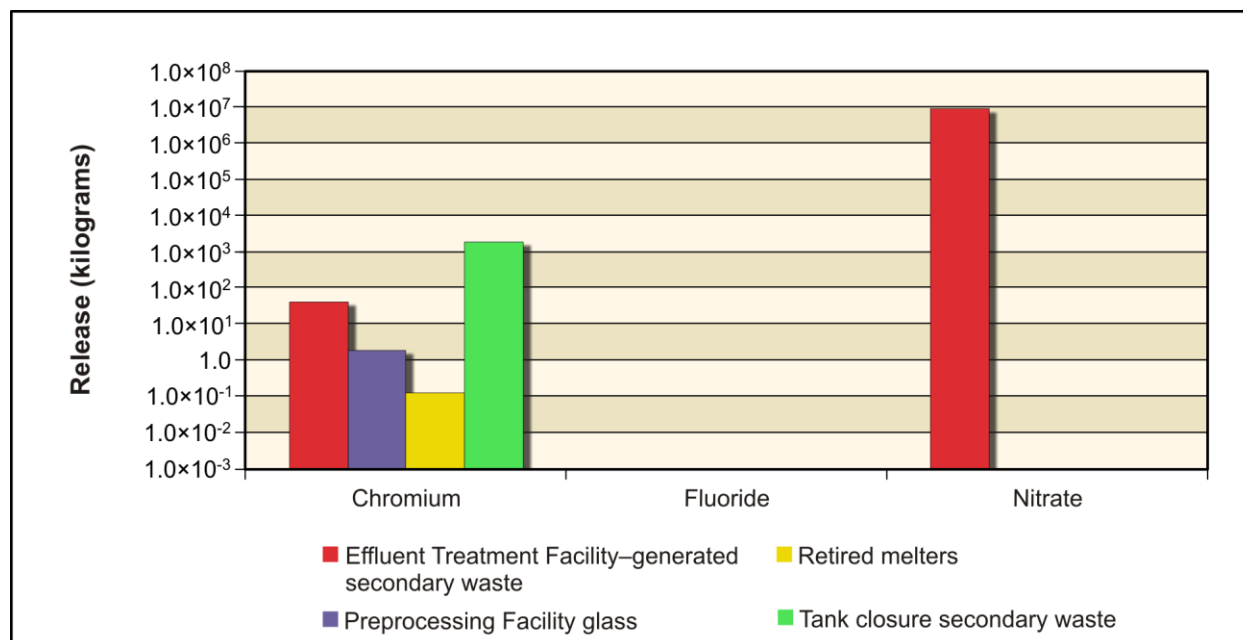


Figure 5-1055. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5-1056 shows the release from IDF-East to groundwater of the radiological risk drivers and Figure 5-1057, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Approximately 40 percent of the iodine-129 and 58 percent of the technetium-99 released to the vadose zone reaches groundwater. For chromium and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 58 percent of the radionuclides (curies) released to the vadose zone

during the period of analysis reach groundwater; approximately 100 percent of the chemicals (kilograms) reach groundwater.

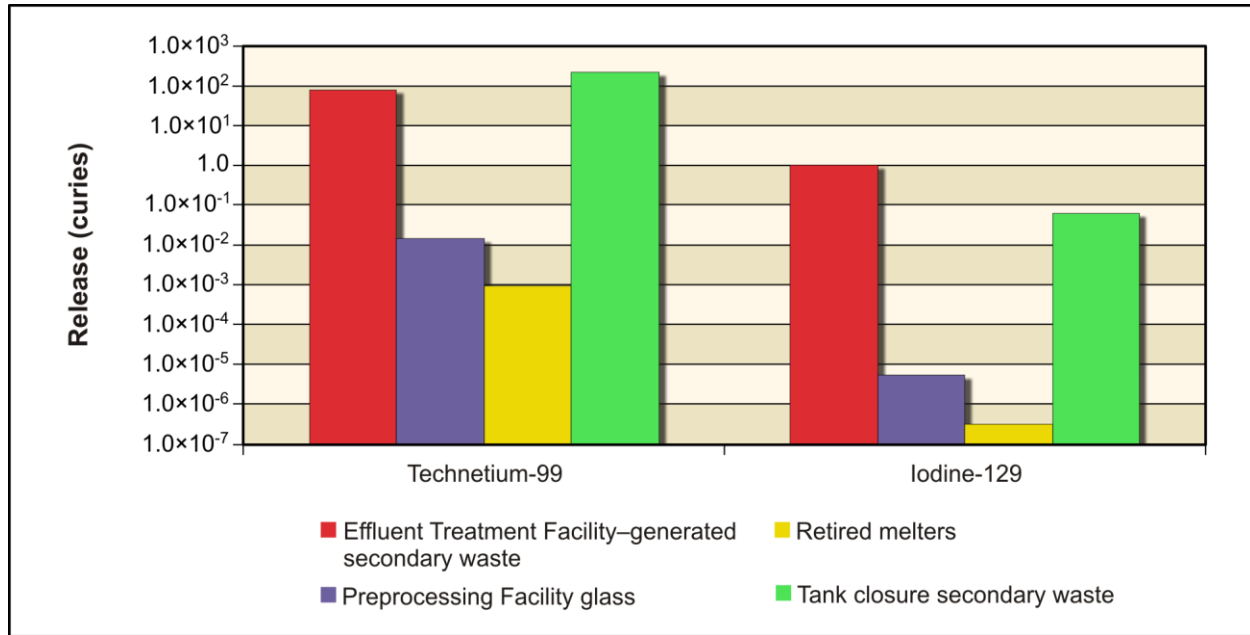


Figure 5-1056. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

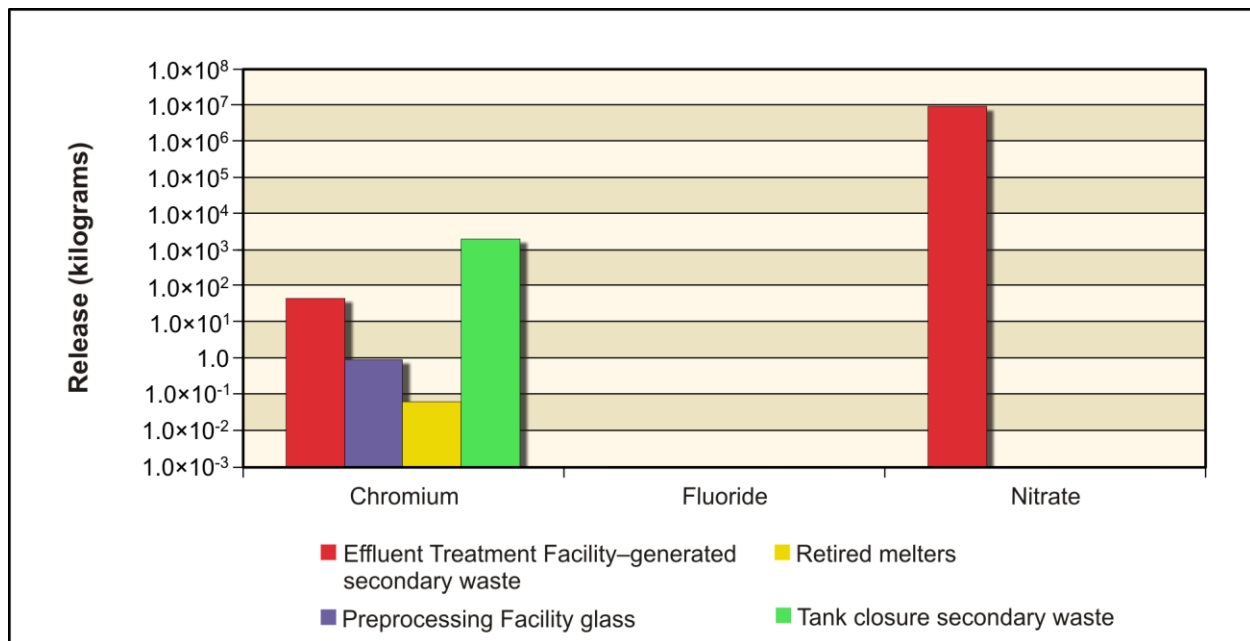


Figure 5-1057. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5-1058 shows the release to the Columbia River of the radiological risk drivers and Figure 5-1059, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About

96 percent of the radionuclides (curies) released to groundwater during the period of analysis reach the river; approximately 99 percent of the chemicals (kilograms) reach the river.

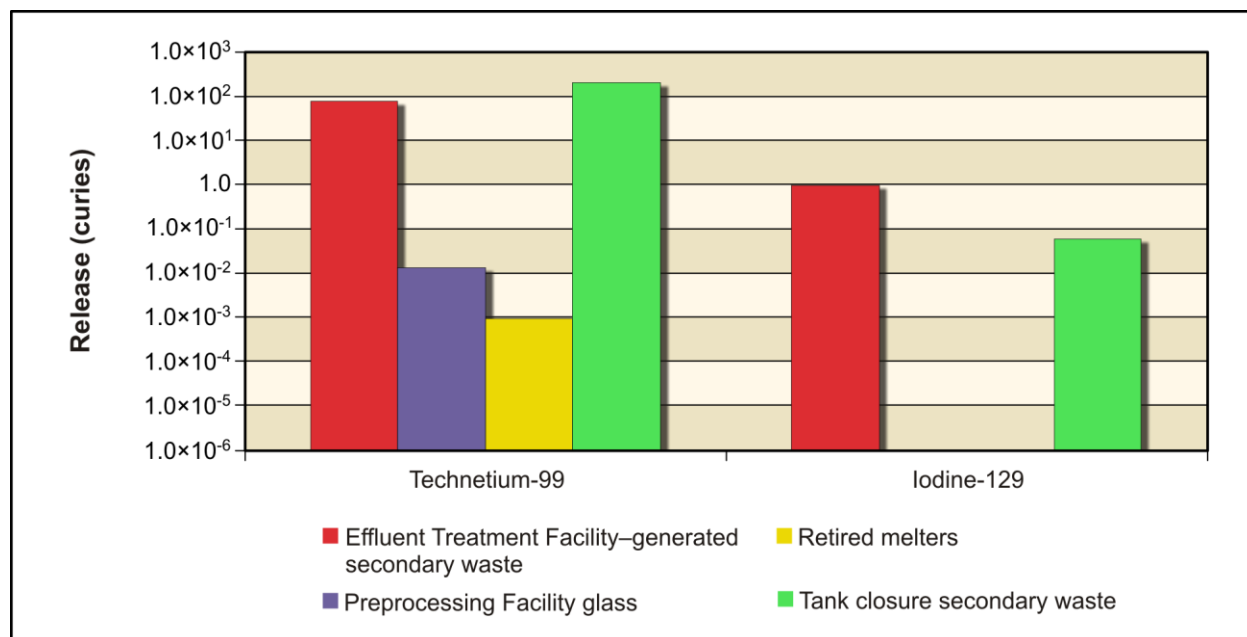


Figure 5-1058. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

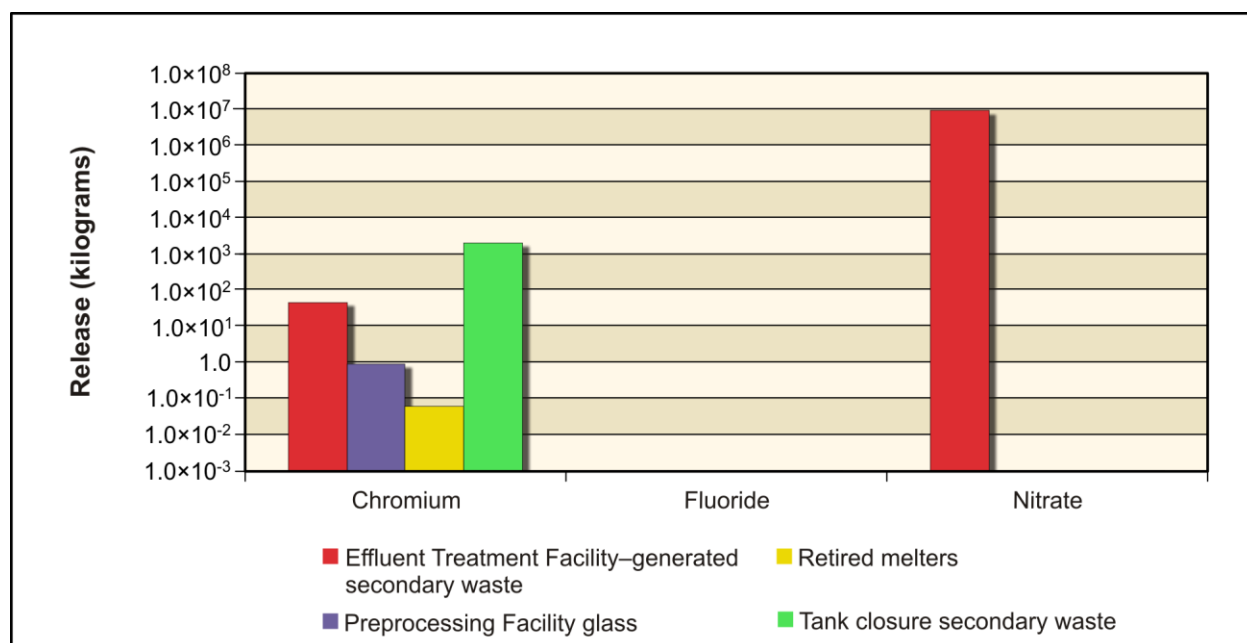


Figure 5-1059. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5-1060 through 5-1065, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste.

Figure 5–1060 shows the release to the vadose zone of the radiological risk drivers and Figure 5–1061, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. For chromium and nitrate, the predominant source is waste management secondary and onsite waste.

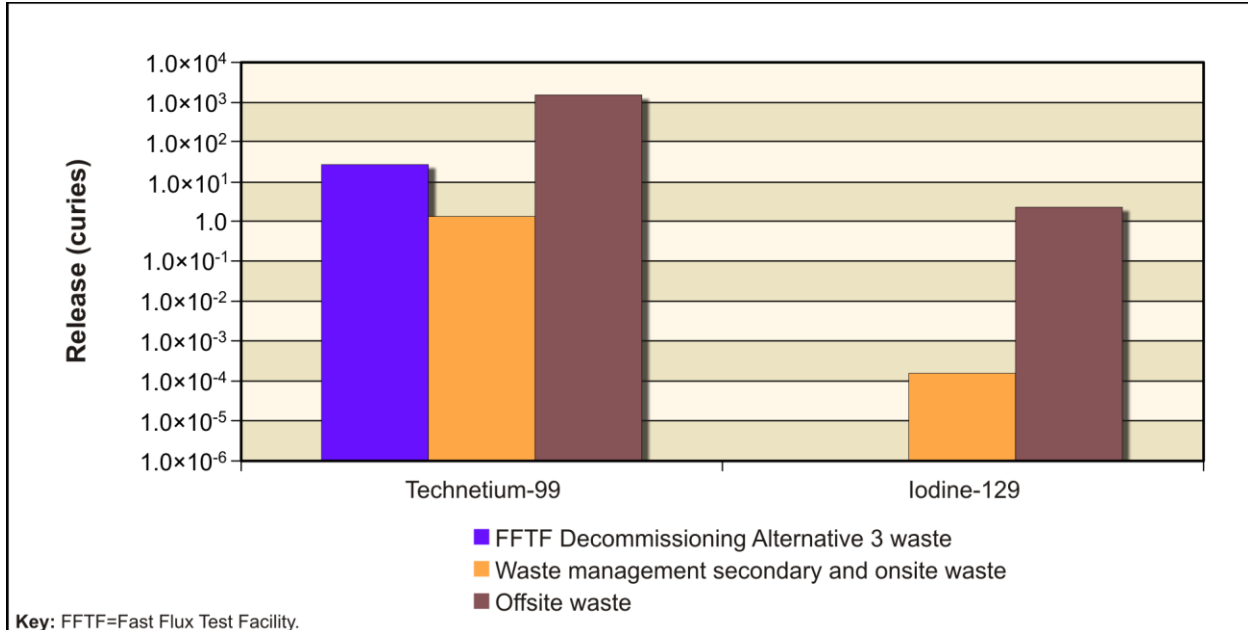


Figure 5–1060. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

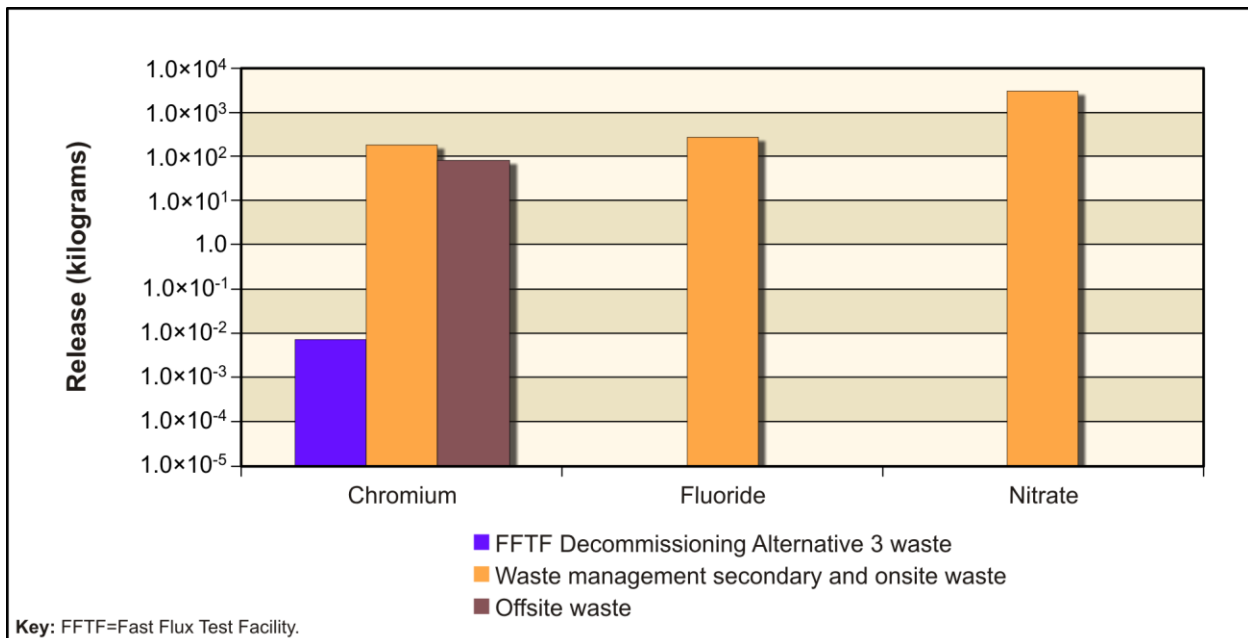


Figure 5–1061. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–1062 shows the release to groundwater of the radiological risk drivers and Figure 5–1063, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 98 percent of the radionuclides (curies) released to the vadose zone during the period of analysis reach groundwater; approximately 100 percent of the chemicals (kilograms) reach groundwater.

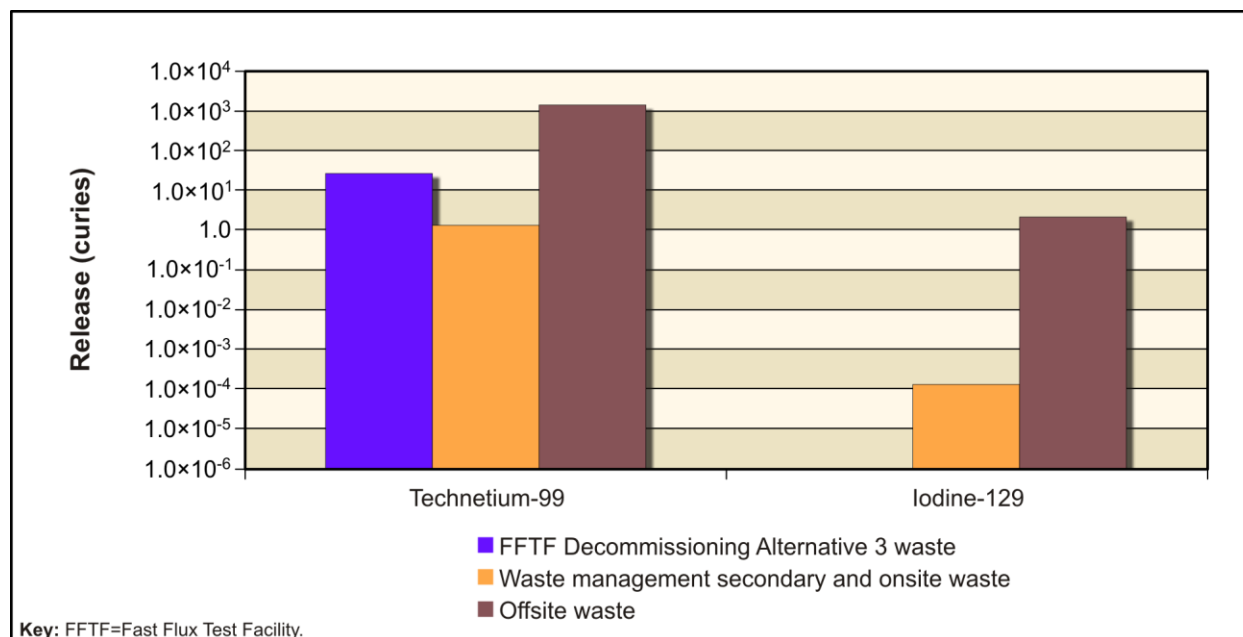


Figure 5–1062. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

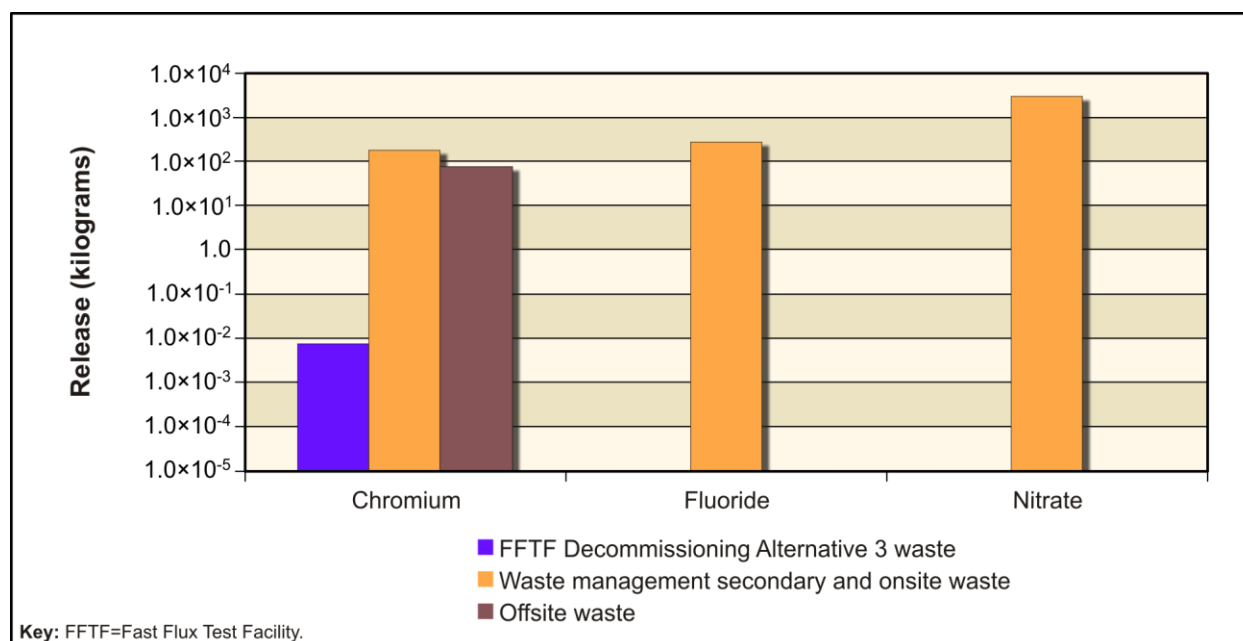


Figure 5–1063. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–1064 shows the release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–1065, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclides (curies) and chemicals (kilograms) released to groundwater during the period of analysis reach the river.

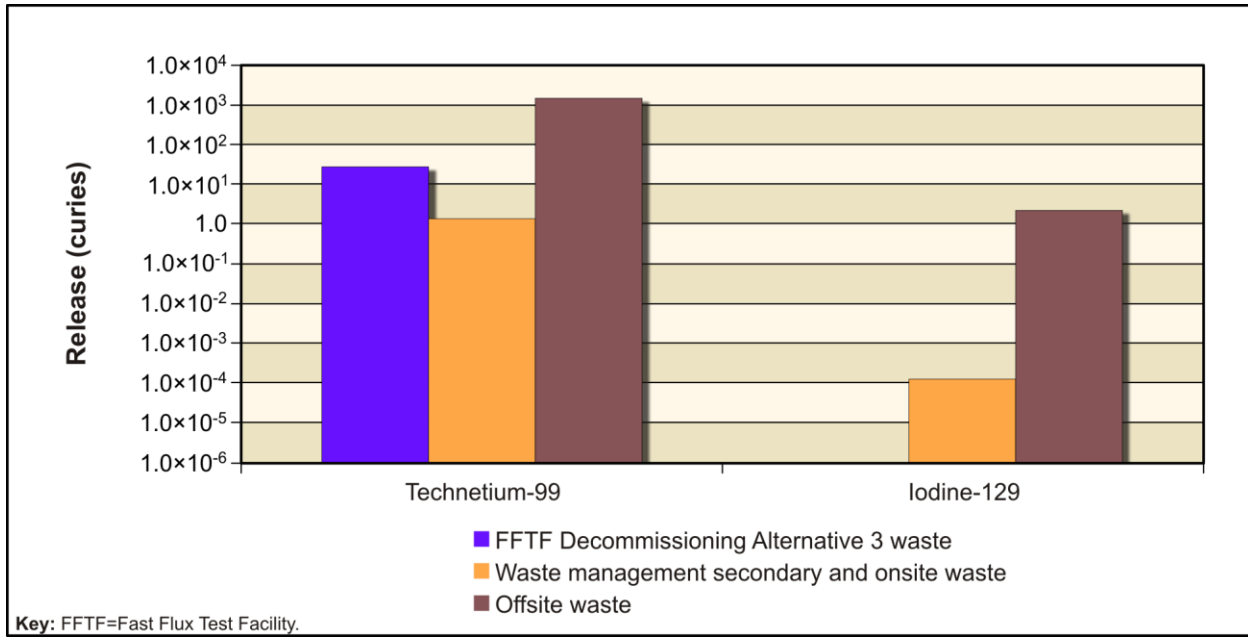


Figure 5–1064. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

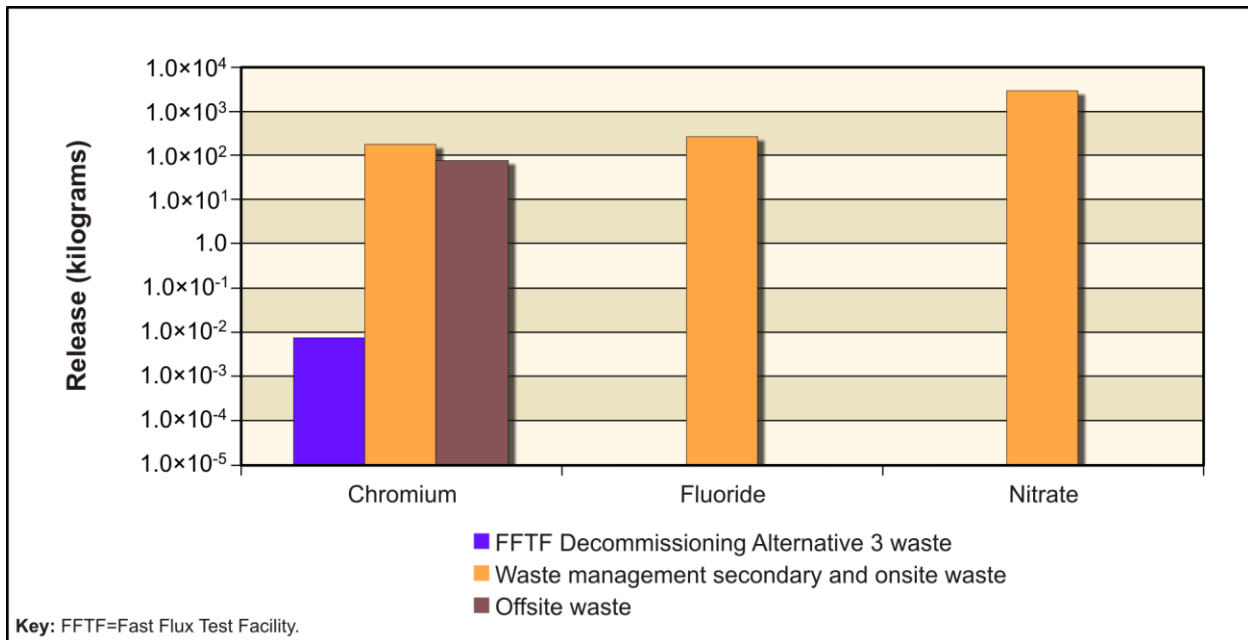


Figure 5–1065. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–1066 shows the release to the vadose zone of the radiological risk drivers and Figure 5–1067, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source).

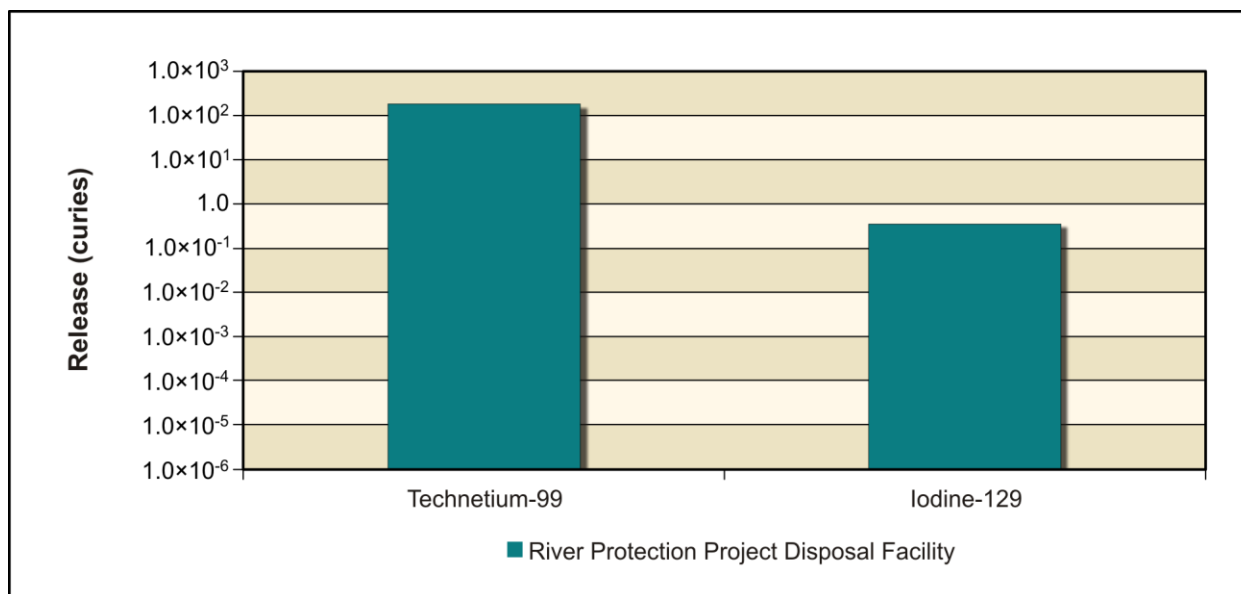


Figure 5–1066. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

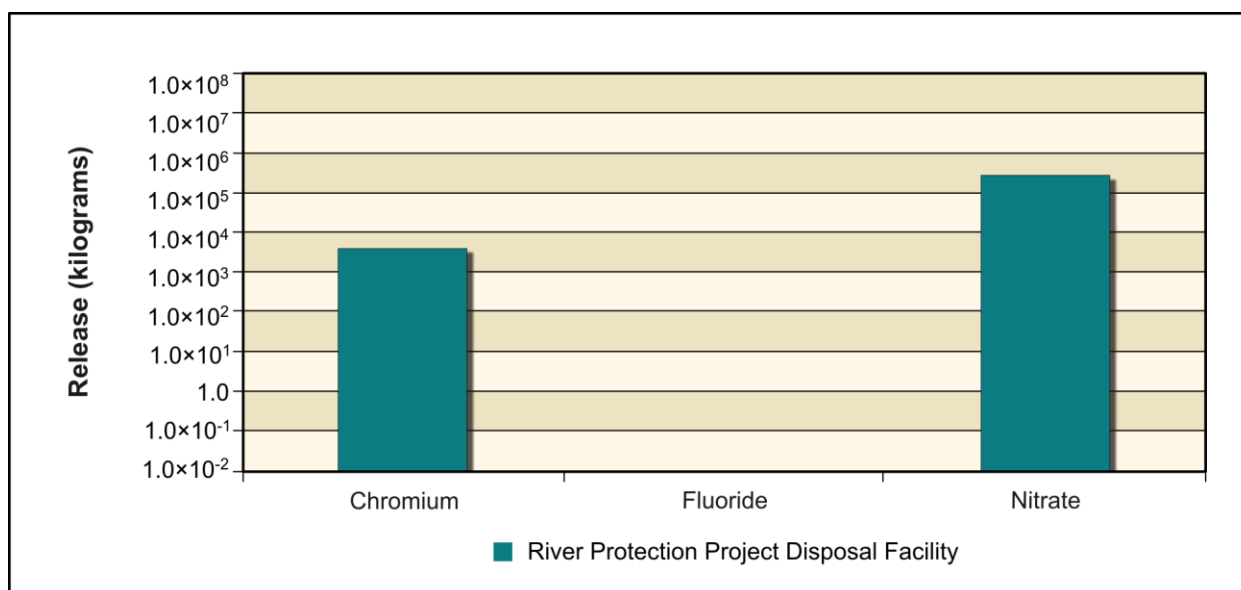


Figure 5–1067. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–1068 shows the release to groundwater of the radiological risk drivers and Figure 5–1069, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of

moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 100 percent of the radionuclides (curies) released to the vadose zone during the period of analysis reach groundwater; approximately 100 percent of the chemicals (kilograms) reach groundwater.

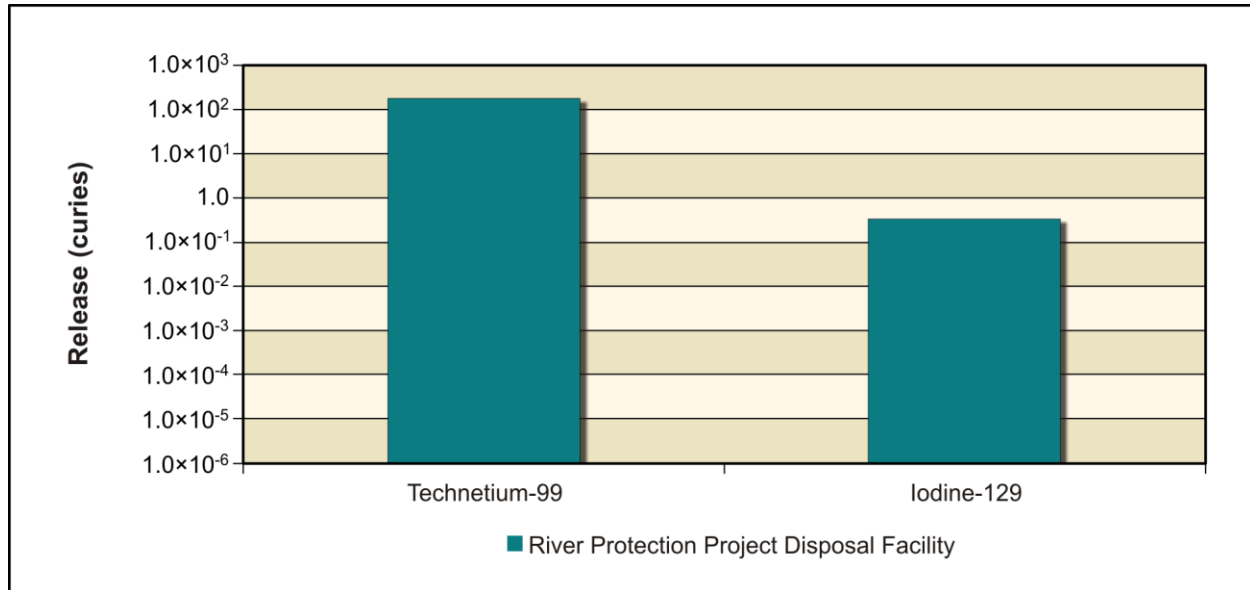


Figure 5–1068. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

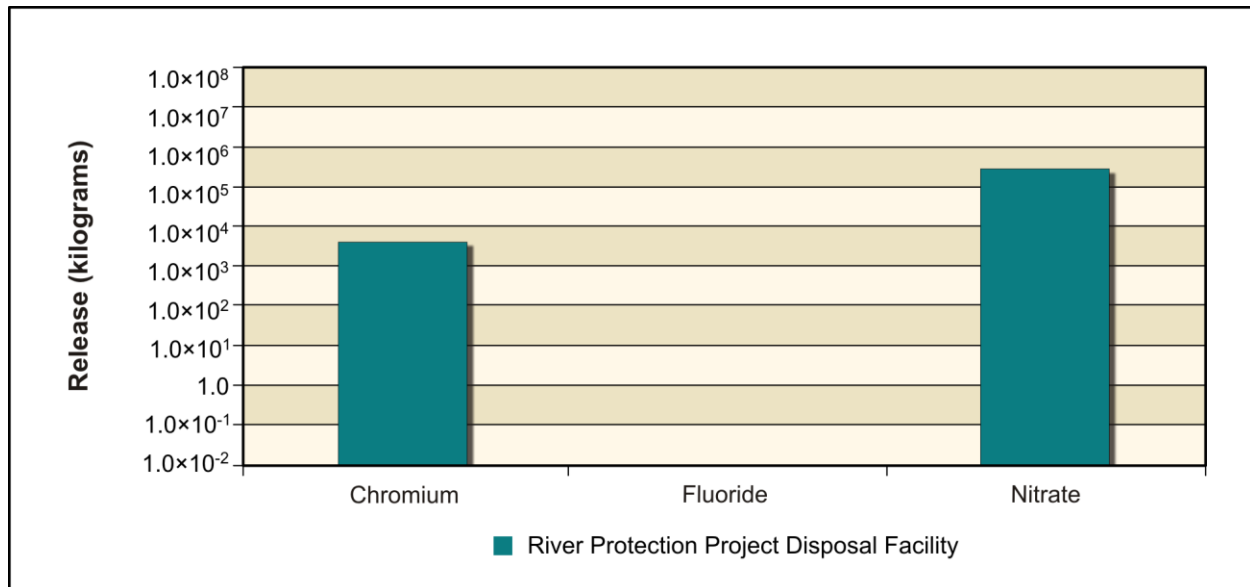


Figure 5–1069. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–1070 shows the release to the Columbia River of the radiological risk drivers and Figure 5–1071, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. Overall, about 100 percent of the radionuclides (curies) released to groundwater during the period of analysis reach the river; likewise, approximately 100 percent of the chemicals (kilograms) reach the river.

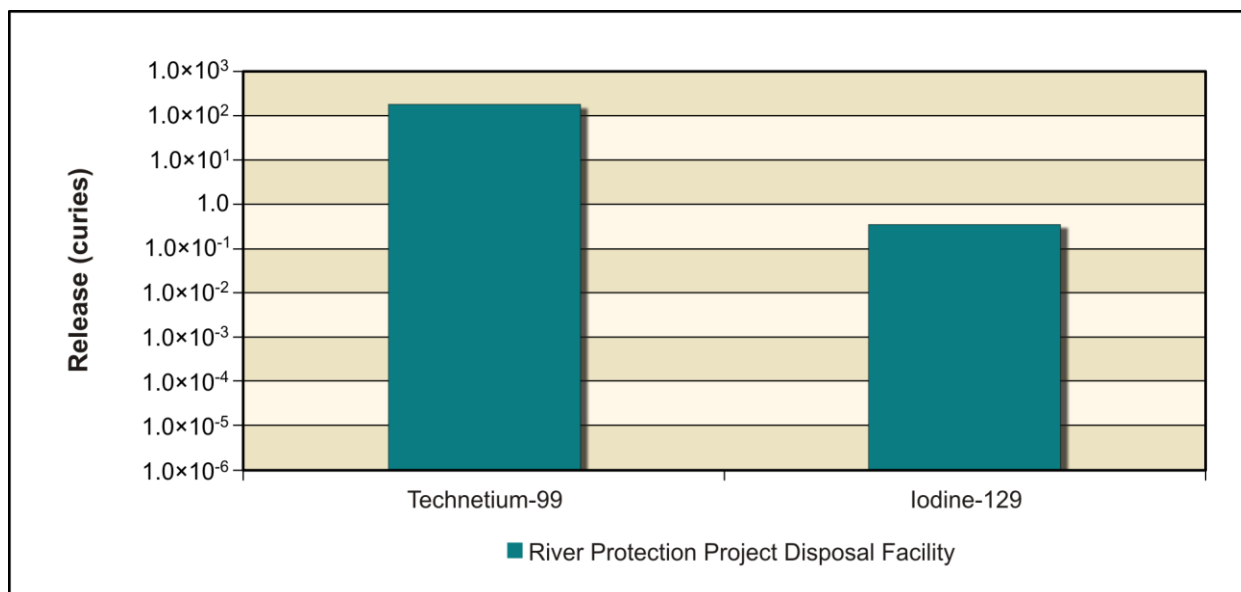


Figure 5–1070. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

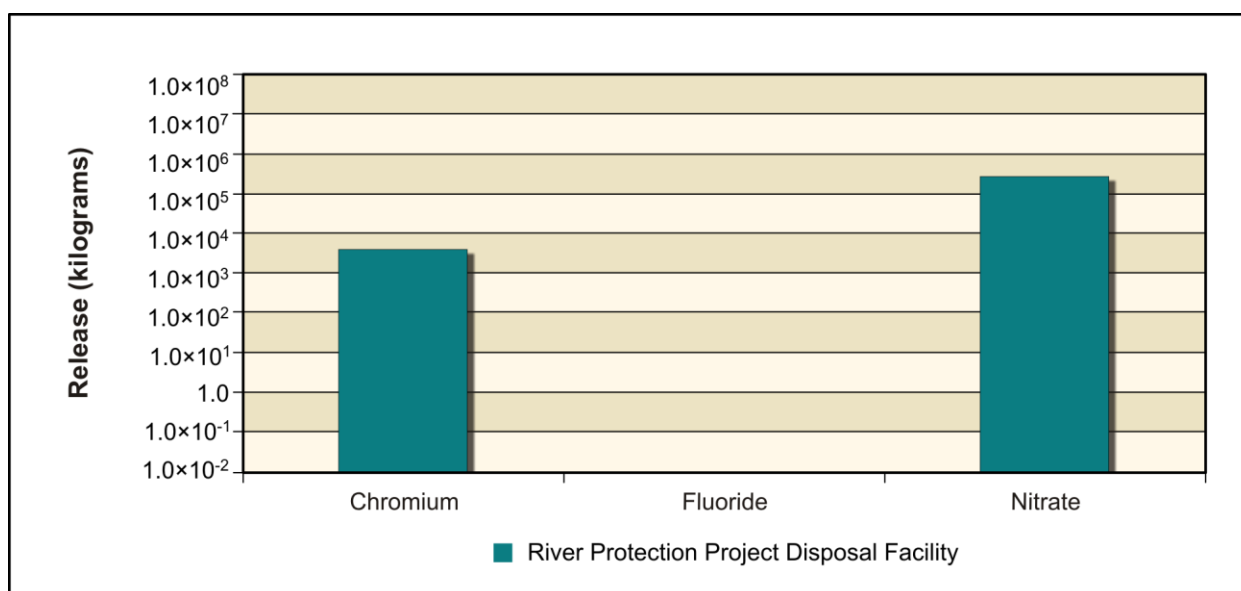
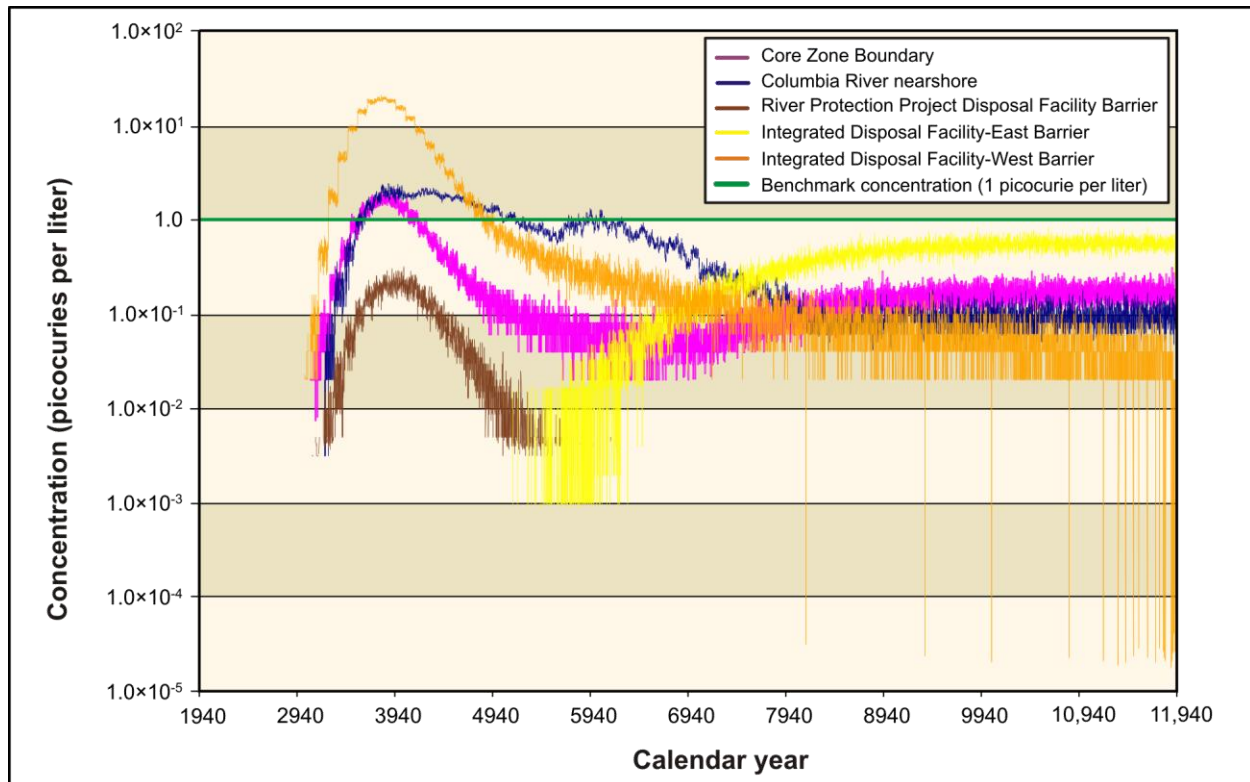


Figure 5–1071. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Base Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations.

Figures 5–1072 through 5–1075 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate. Releases from IDF-East, IDF-West, and the RPPDF cause iodine-129 concentrations in groundwater to exceed benchmark concentrations in the earlier part of the period of analysis at the IDF-West barrier by about one order of magnitude and at the Core Zone Boundary and the Columbia River nearshore by less than one order of magnitude. Iodine-129 concentrations at the IDF-East barrier begin to increase beginning around CY 4500 and steadily increase before remaining constant at less than an order of magnitude below the benchmark concentration until the end of the simulation. Technetium-99 behavior is similar to that of iodine-129. Benchmark concentrations are exceeded by about one order of magnitude early in the analysis at the IDF-West barrier and by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Technetium-99 concentrations at the IDF-East barrier remain an order of magnitude below the benchmark concentration throughout the analysis period. Nitrate and chromium do not exceed benchmark concentrations at the IDF-West barrier, IDF-East barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore. Table 5–116 shows the maximum concentrations in groundwater. Exceedances of the benchmark concentrations occur primarily at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where high concentrations of technetium-99 and iodine-129 exceed their respective benchmarks. No other exceedances of benchmark concentration were recorded during the simulation.



**Figure 5–1072. Waste Management Alternative 3, Disposal Group 3, Base Case,
Iodine-129 Concentration Versus Time**

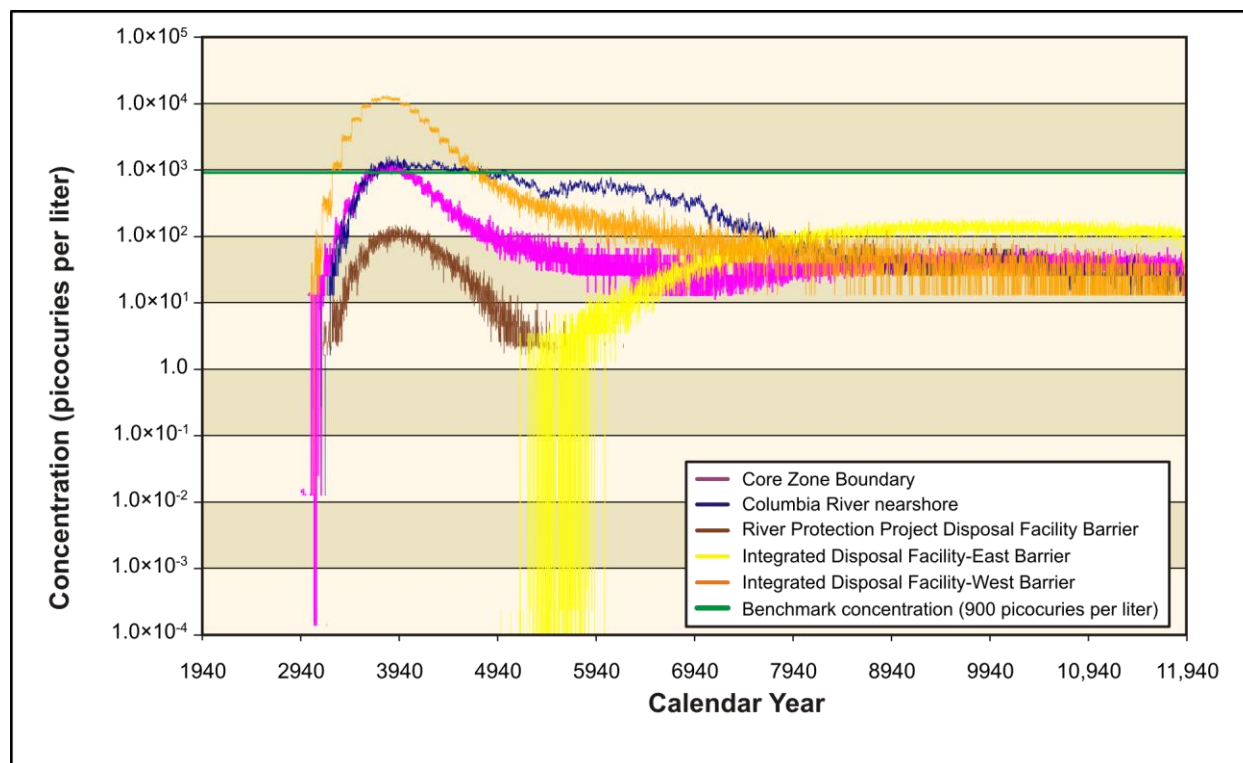


Figure 5-1073. Waste Management Alternative 3, Disposal Group 3, Base Case, Technetium-99 Concentration Versus Time

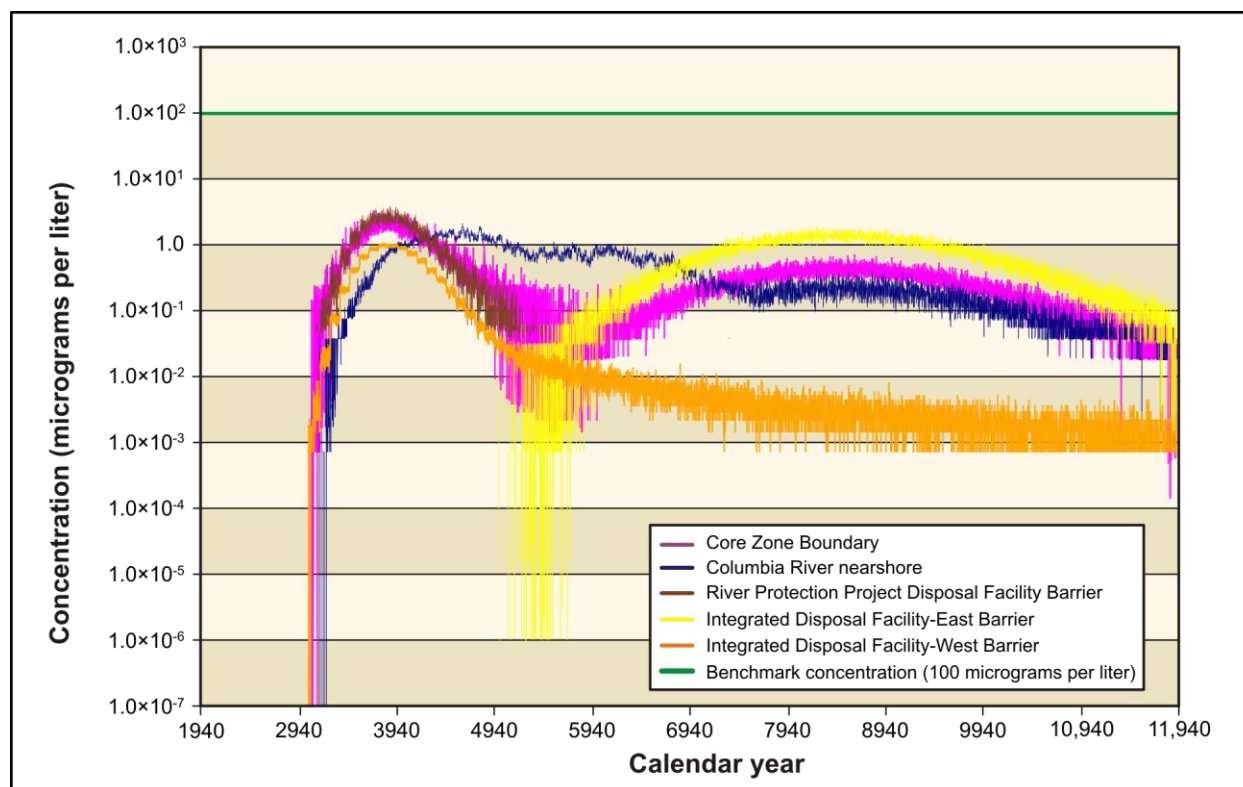


Figure 5-1074. Waste Management Alternative 3, Disposal Group 3, Base Case, Chromium Concentration Versus Time

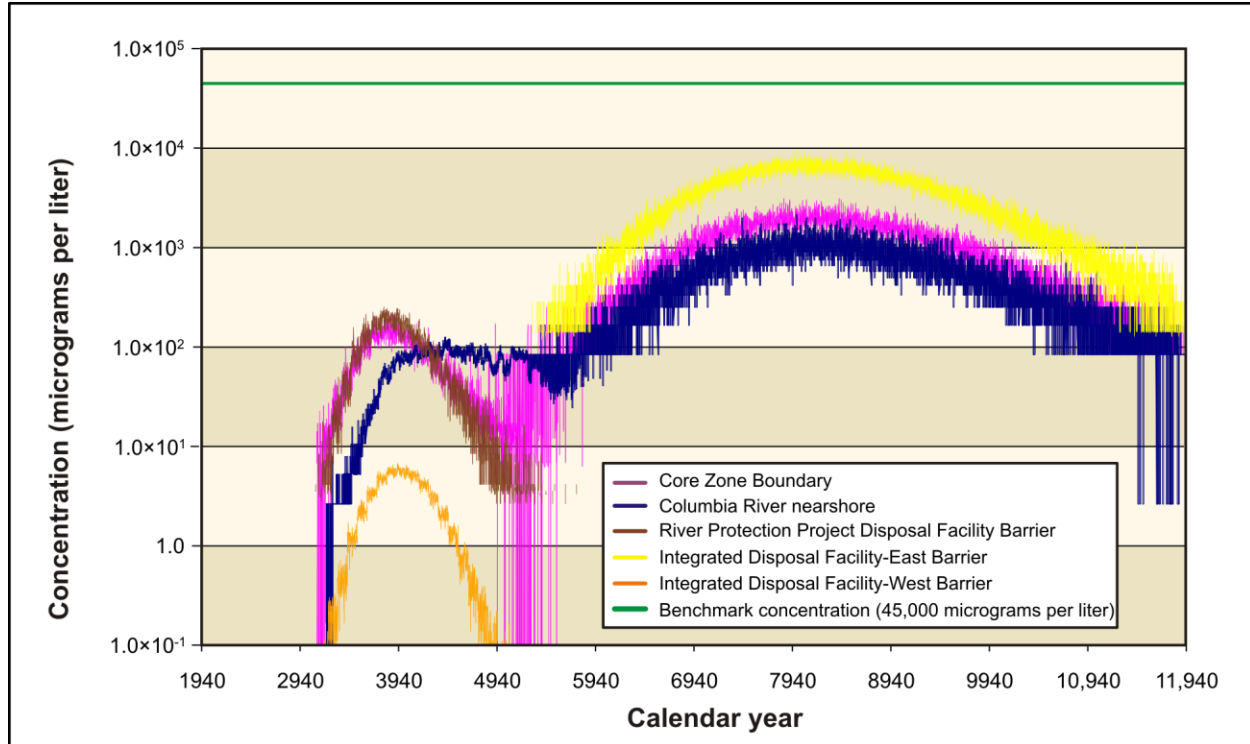


Figure 5-1075. Waste Management Alternative 3, Disposal Group 3, Base Case, Nitrate Concentration Versus Time

Table 5-116. Waste Management Alternative 3, Disposal Group 3, Base Case, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	194 (10,188)	13,200 (3818)	147 (3896)	1,370 (3859)	1,670 (3920)	900
Iodine-129	0.8 (9907)	20.6 (3794)	0.3 (4027)	2.1 (3937)	2.4 (3872)	1
Chemical (micrograms per liter)						
Chromium	2 (8251)	1 (3813)	4 (3869)	3 (3701)	2 (4608)	100
Fluoride	0 (1940)	1 (4014)	0 (3983)	0 (3937)	0 (4307)	4,000
Nitrate	9,590 (7983)	7 (3927)	248 (3783)	3,130 (7860)	2,140 (7994)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figure 5–1076 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are many orders of magnitude lower than benchmark concentrations. Total uranium concentrations, while minimal, rise late in the period of analysis and remain more than six orders of magnitude below the benchmark concentration during the 10,000-year simulation period.

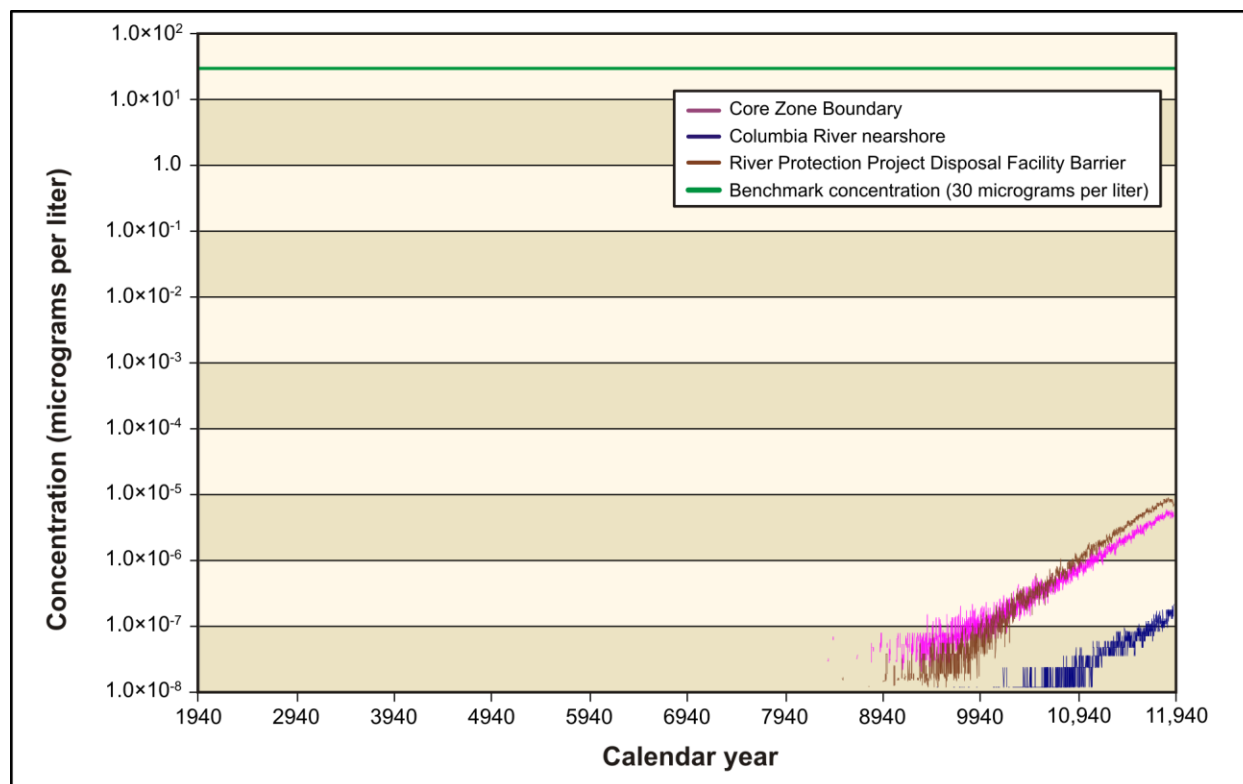


Figure 5–1076. Waste Management Alternative 3, Disposal Group 3, Base Case, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Base Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figure 5–1077 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West and the RPPDF result in a groundwater plume starting in the Core Zone and heading north through Gable Gap. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by one to two orders of magnitude. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–1078). Also by CY 7140, most of the IDF-West and RPPDF plume continues to move north and reaches the Columbia River. By CY 11,885, most of the mass in the IDF-East plume is still moving east toward the Columbia River with only small,

isolated pockets exceeding the benchmark concentration (see Figure 5–1079). Technetium-99 (see Figures 5–1080 through 5–1082) shows similar spatial distributions at selected times and exceeds the benchmark concentrations at approximately the same time and locations. Chromium (see Figures 5–1083 through 5–1085) and nitrate (see Figures 5–1086 through 5–1088) show similar spatial distributions at selected times, but the peak concentrations are lower than iodine-129 and technetium-99 relative to their respective benchmark concentrations. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).

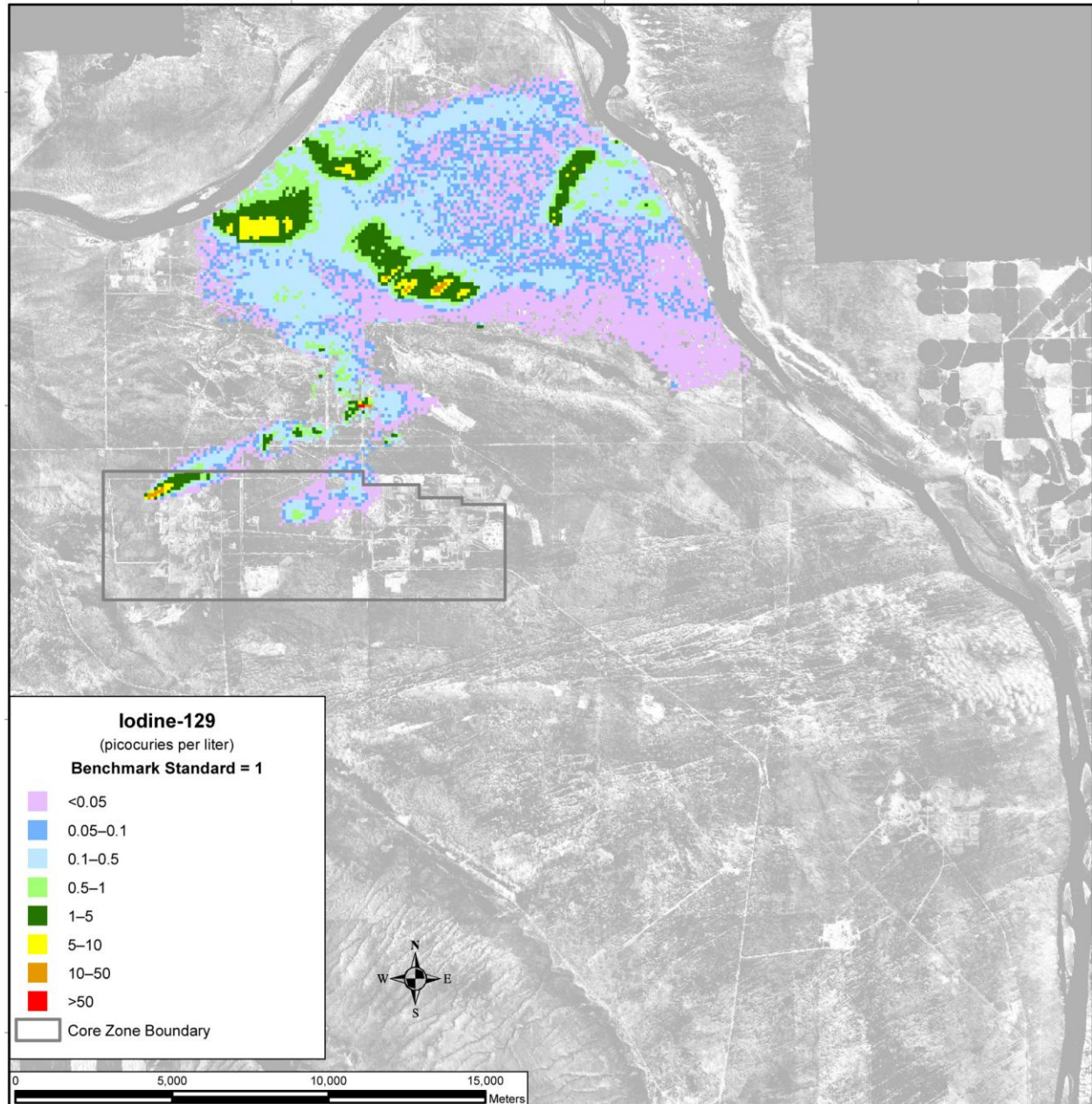
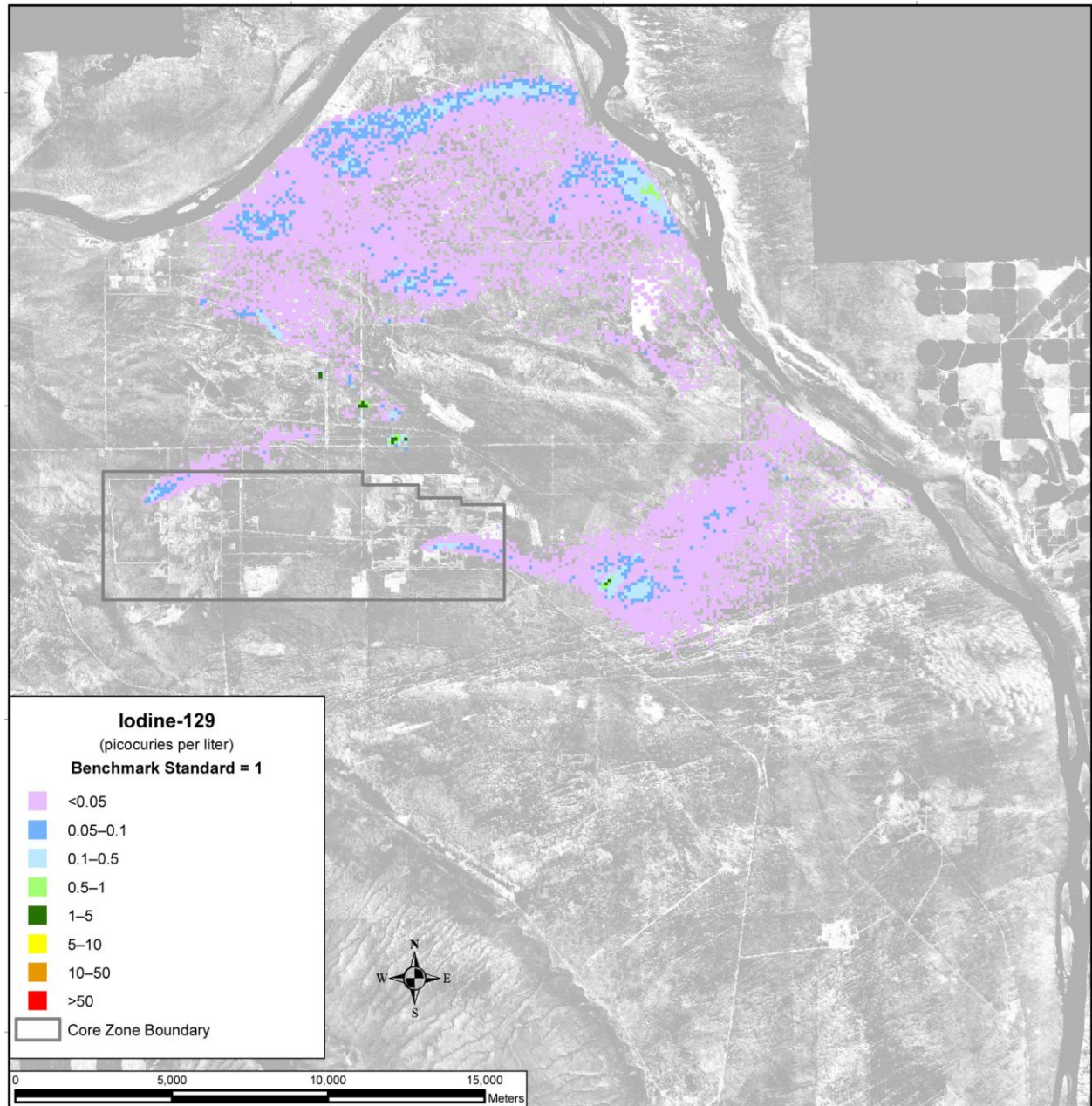


Figure 5–1077. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1078. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140

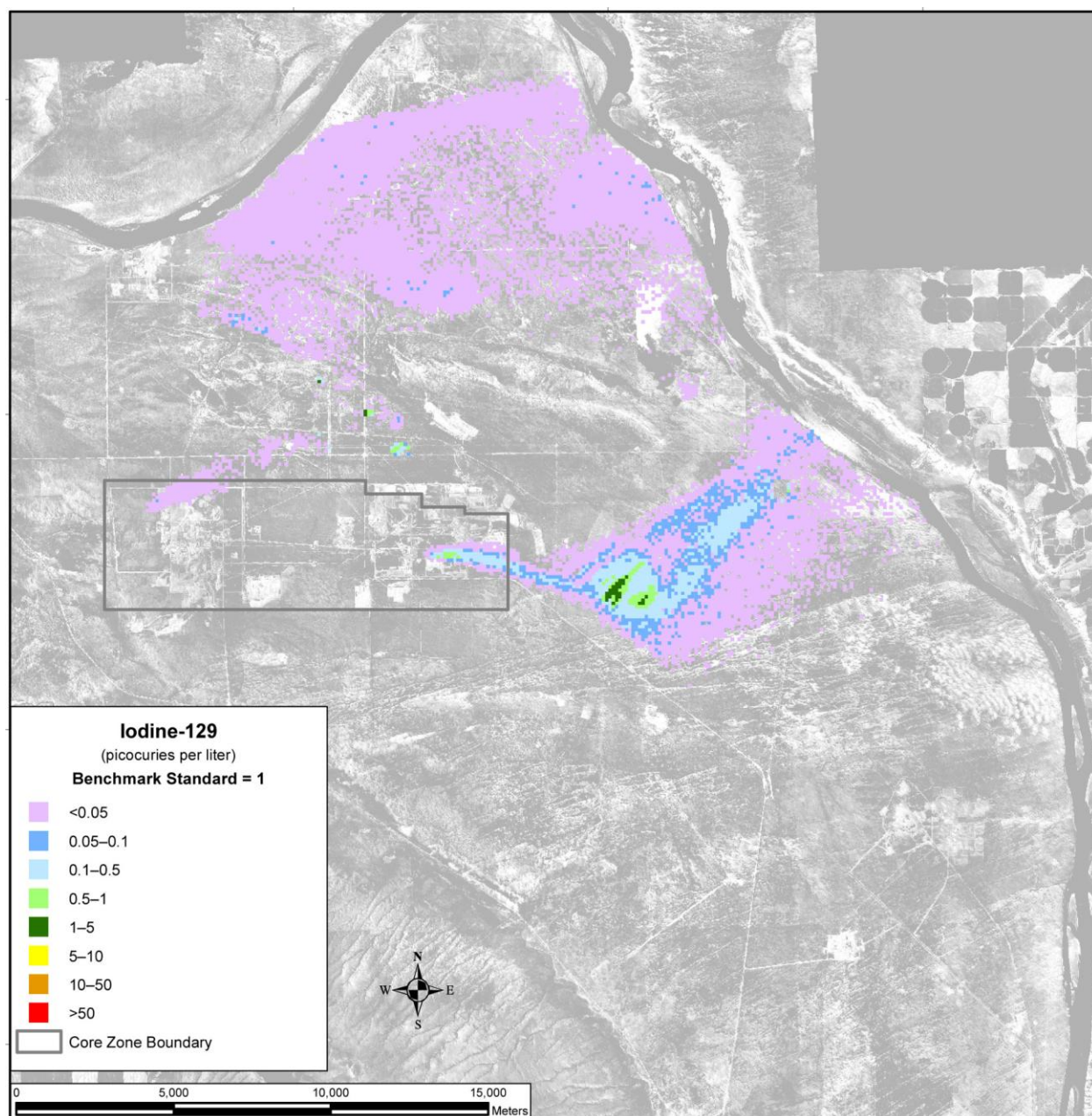
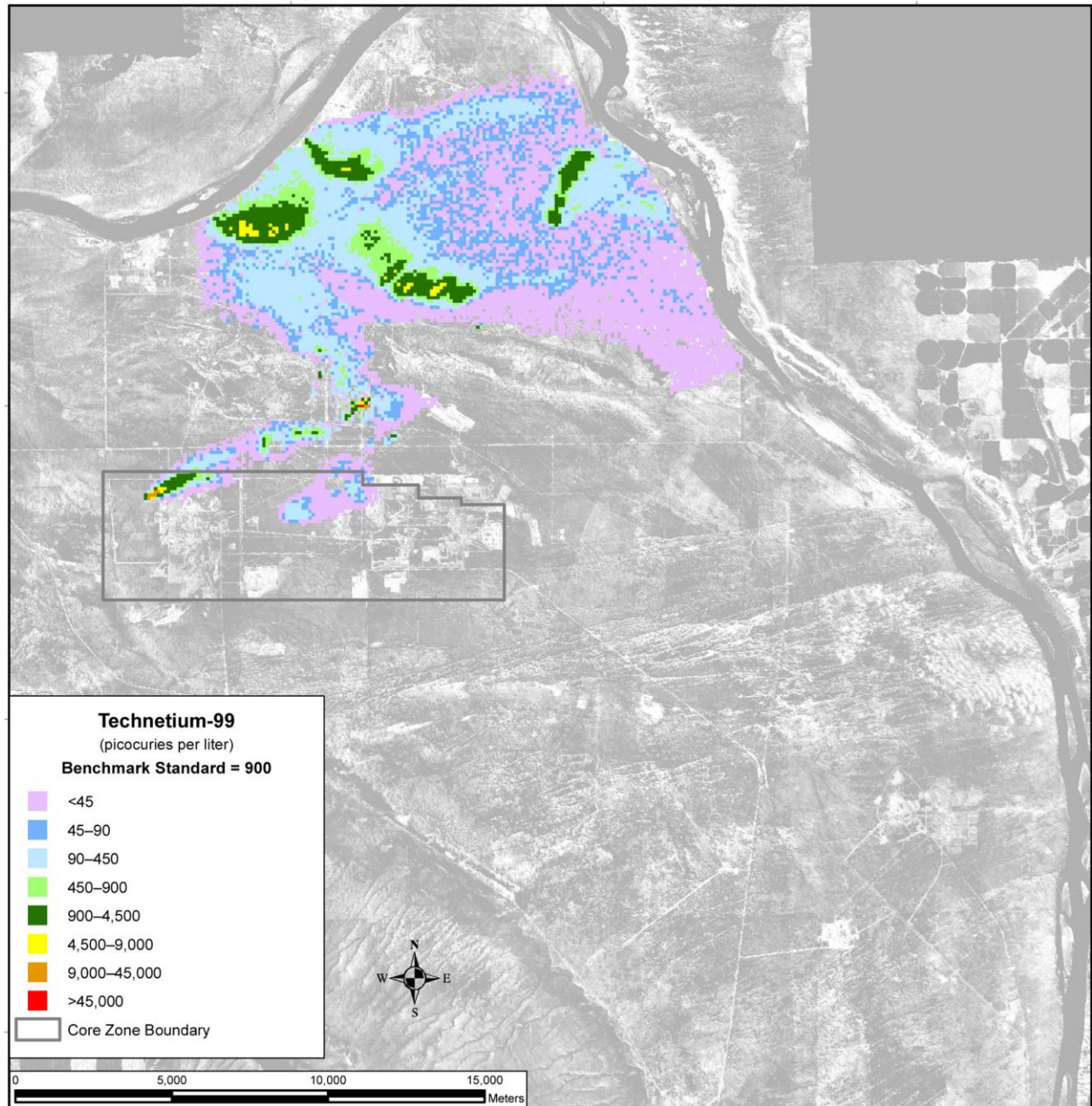
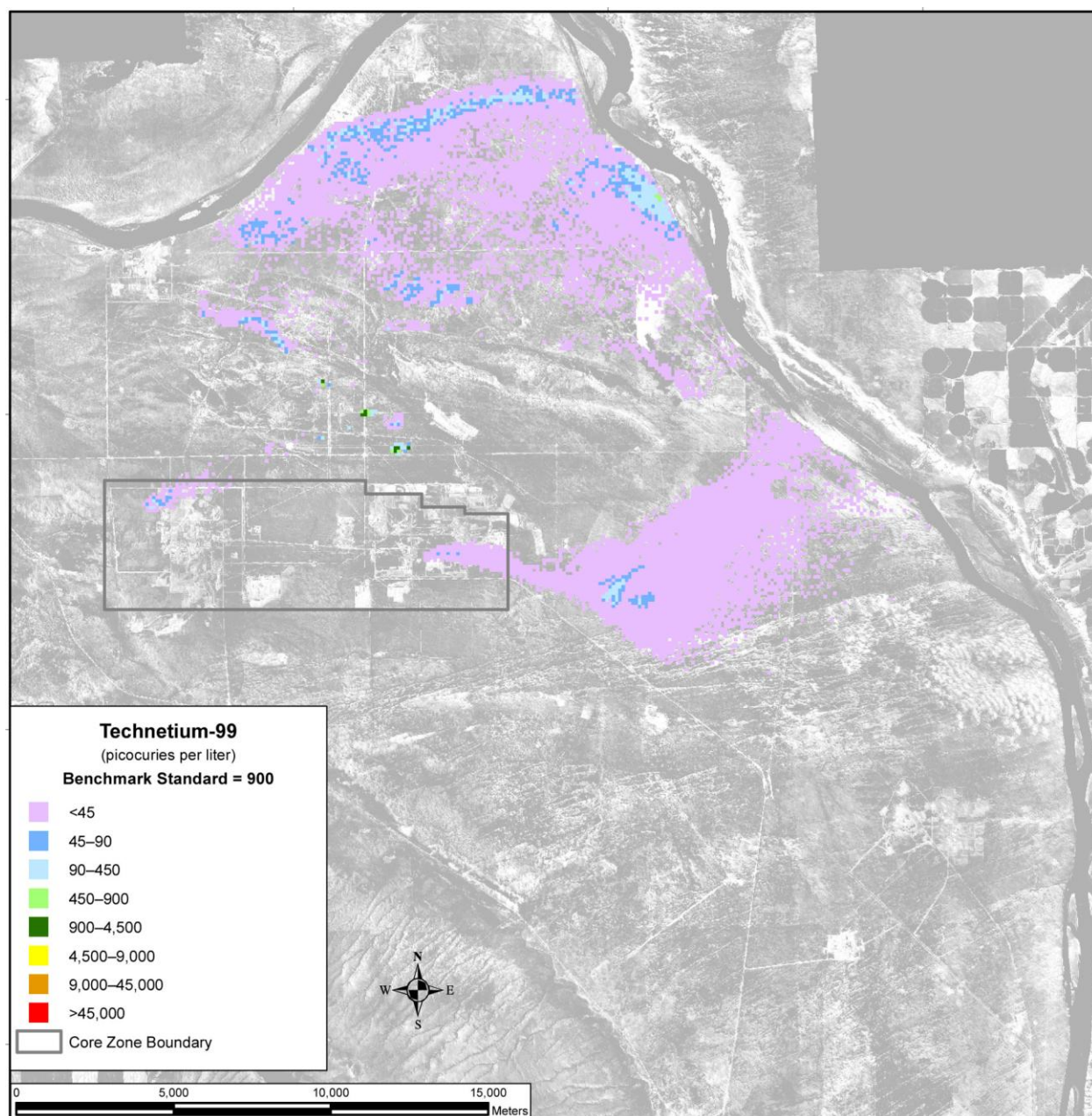


Figure 5–1079. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



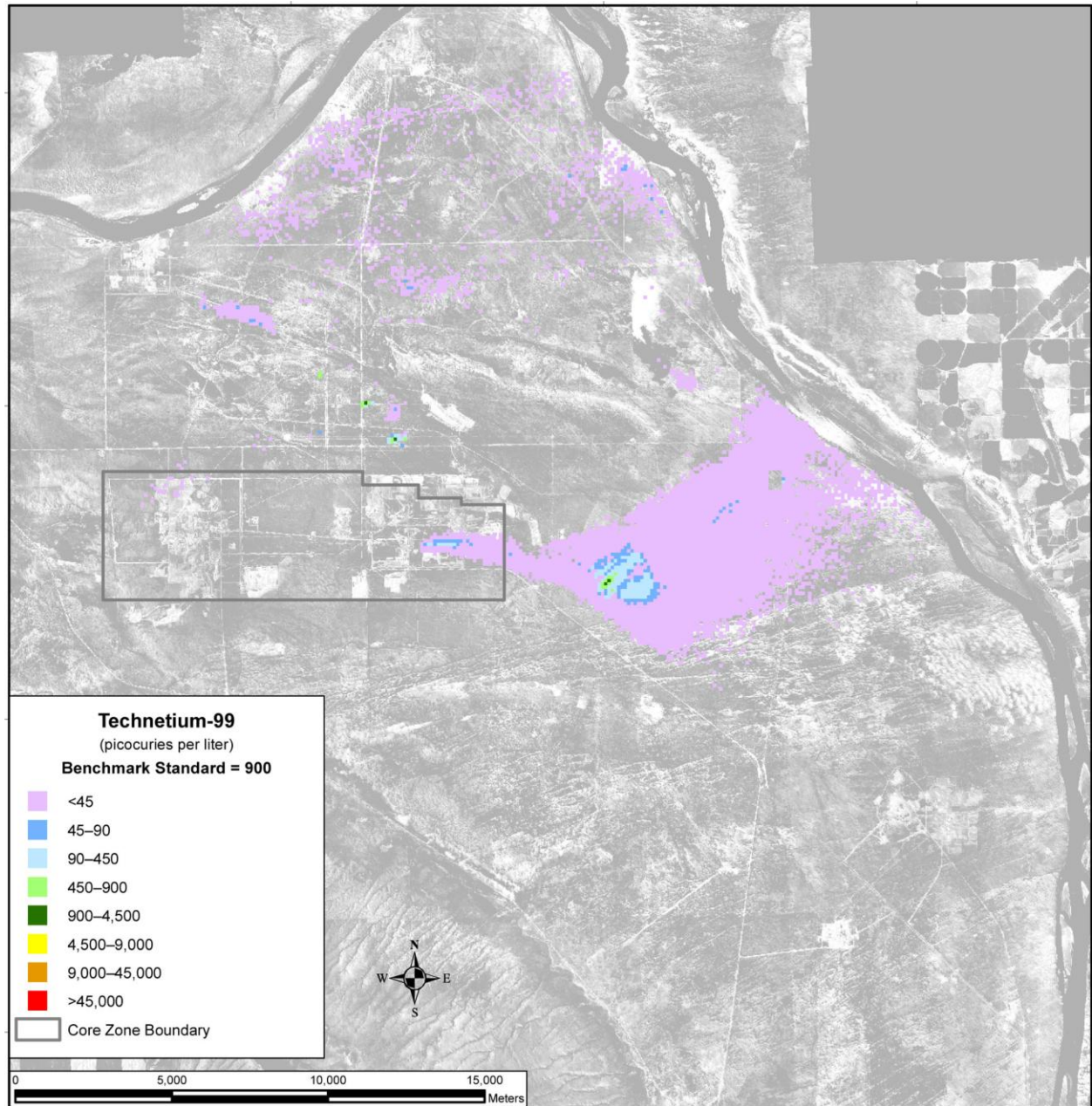
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1080. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5-1081. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1082. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885

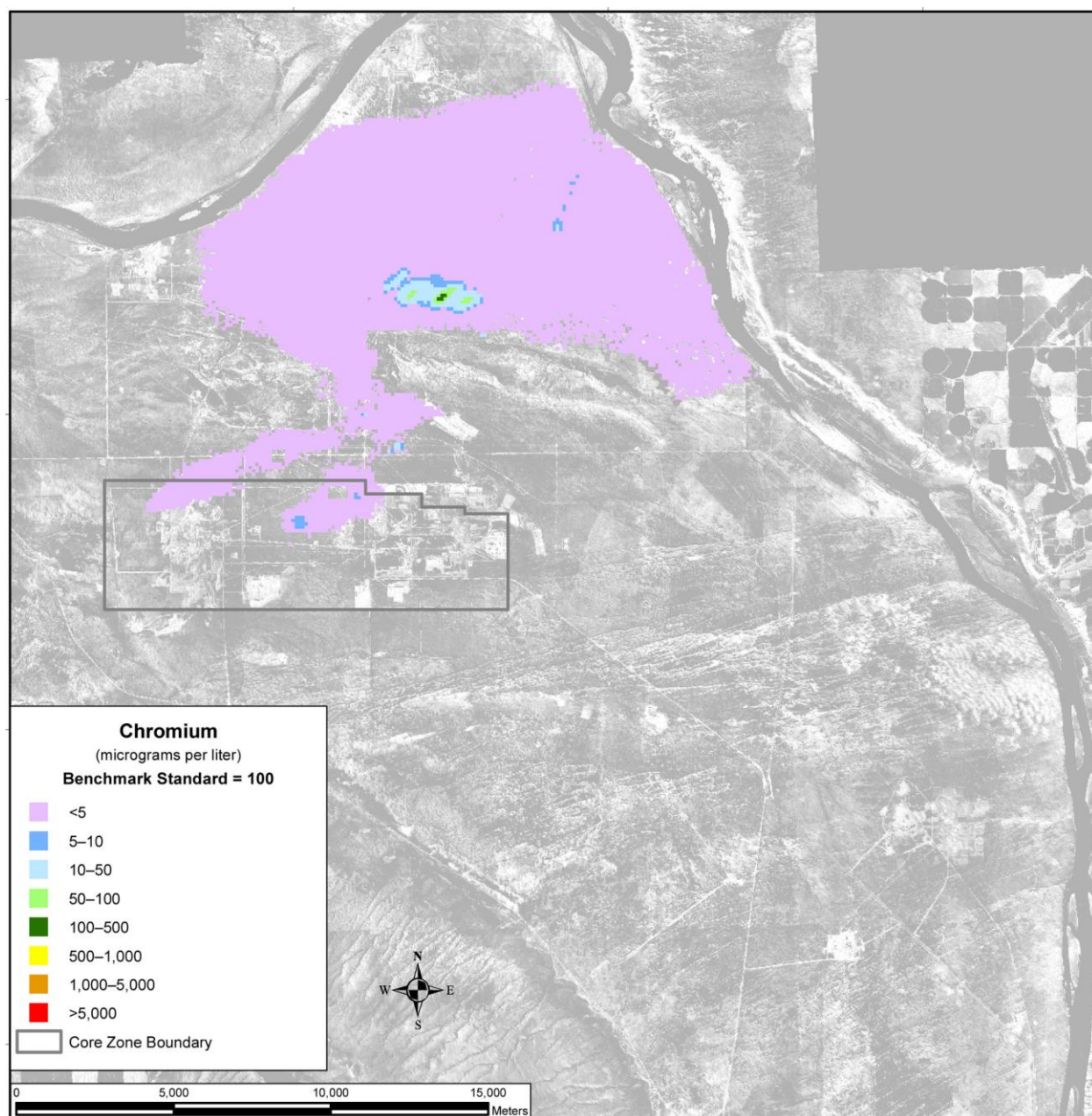
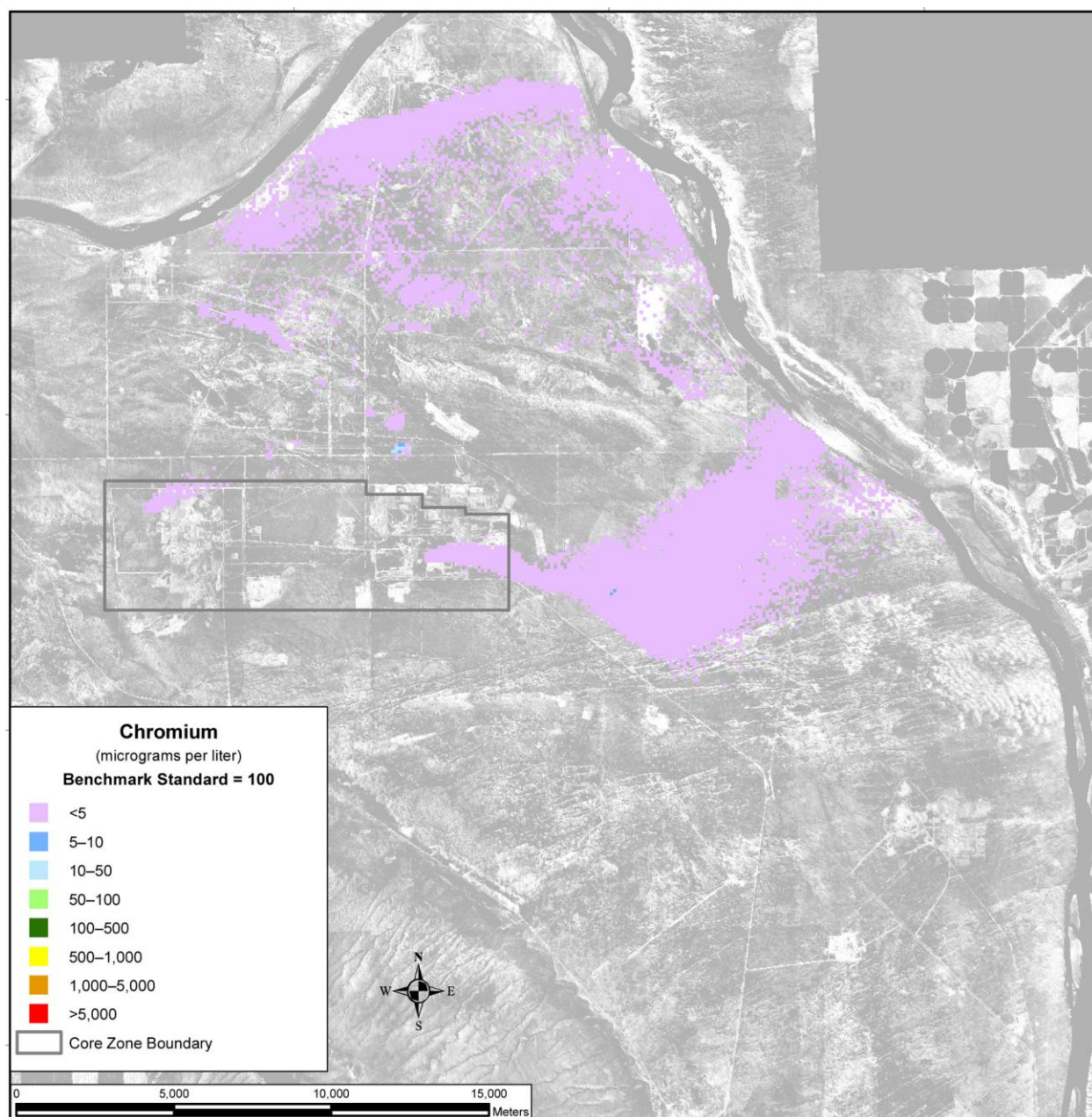
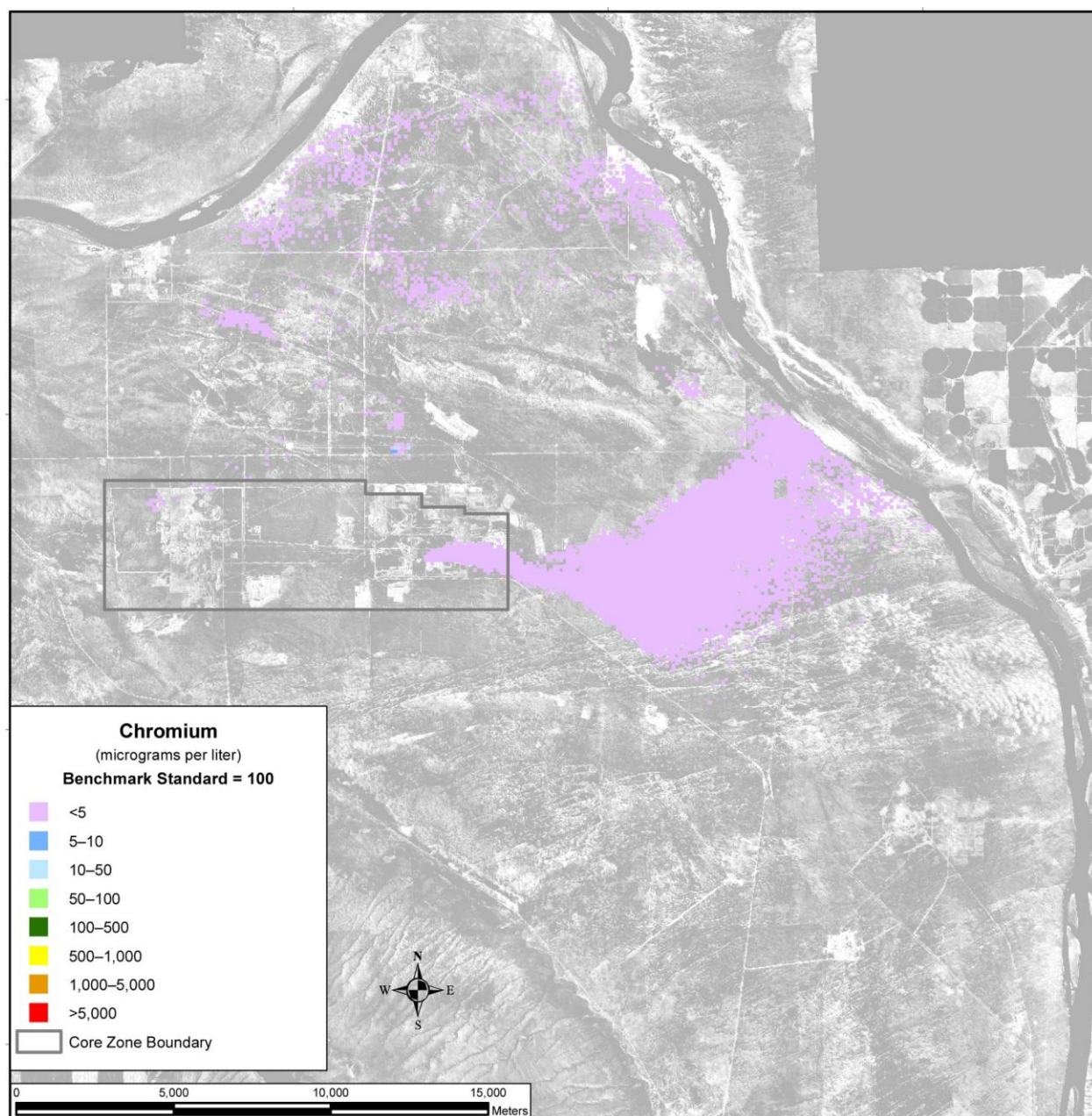


Figure 5–1083. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



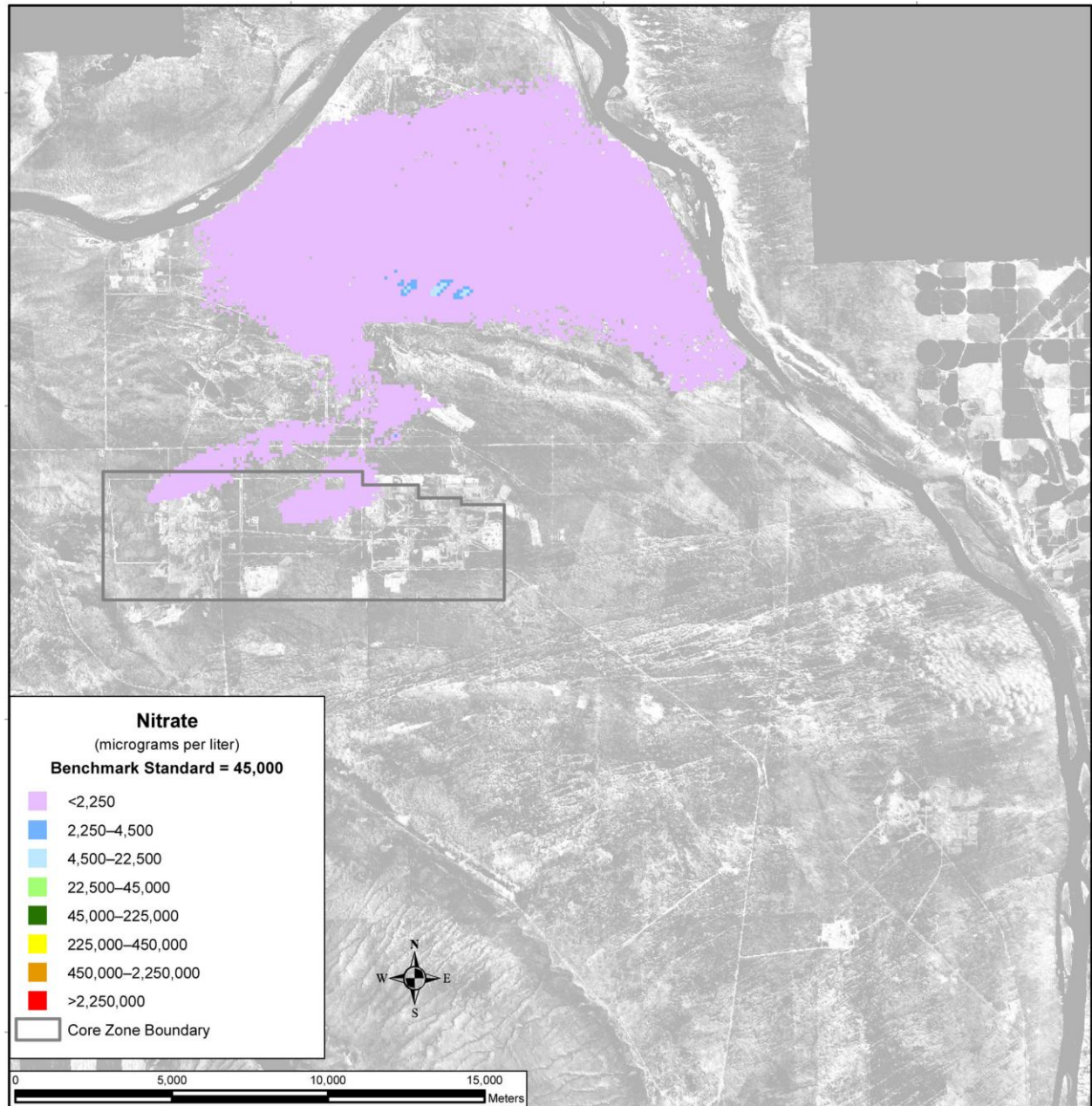
Note: To convert meters to feet, multiply by 3.281.

Figure 5-1084. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



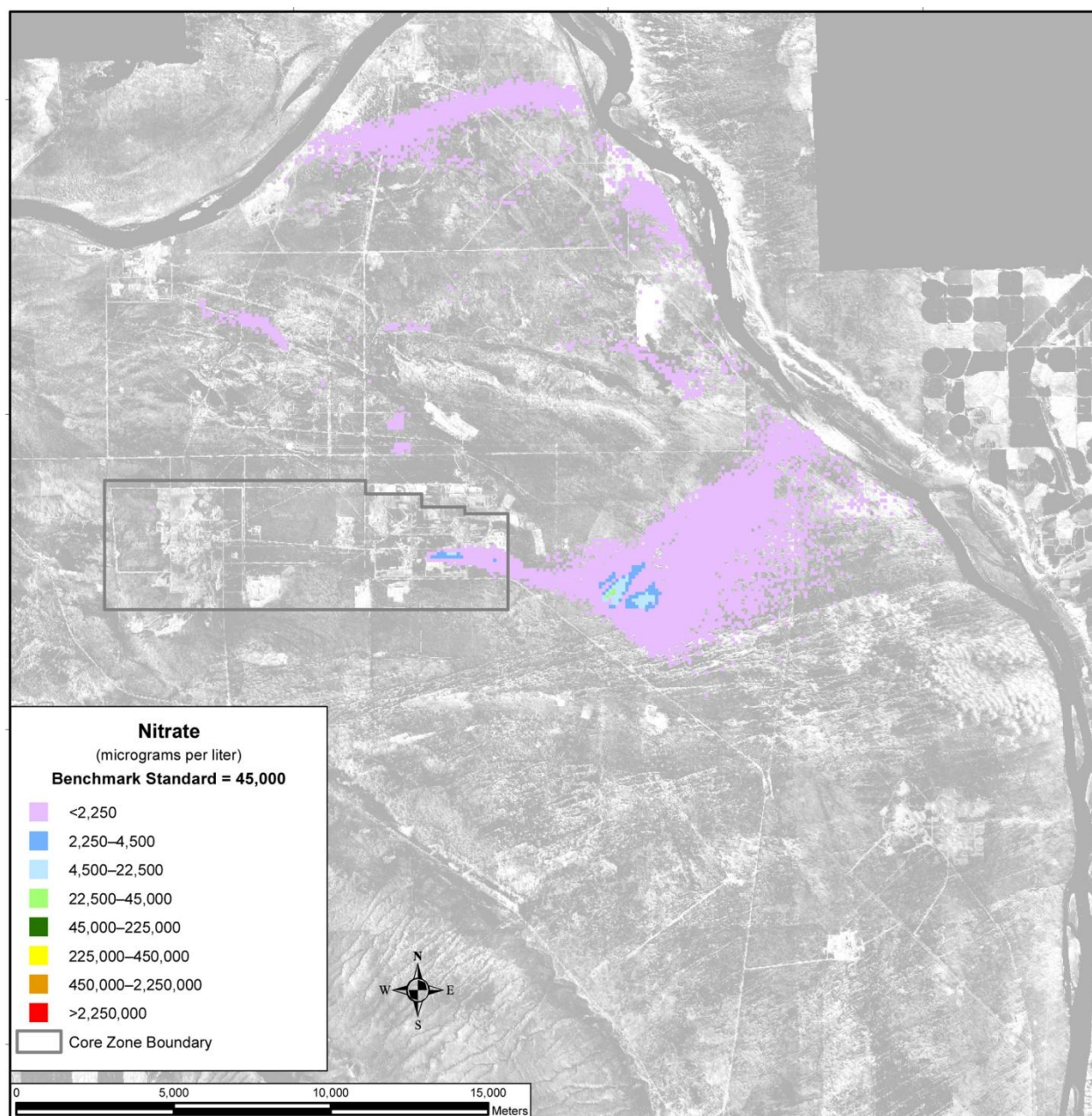
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1085. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



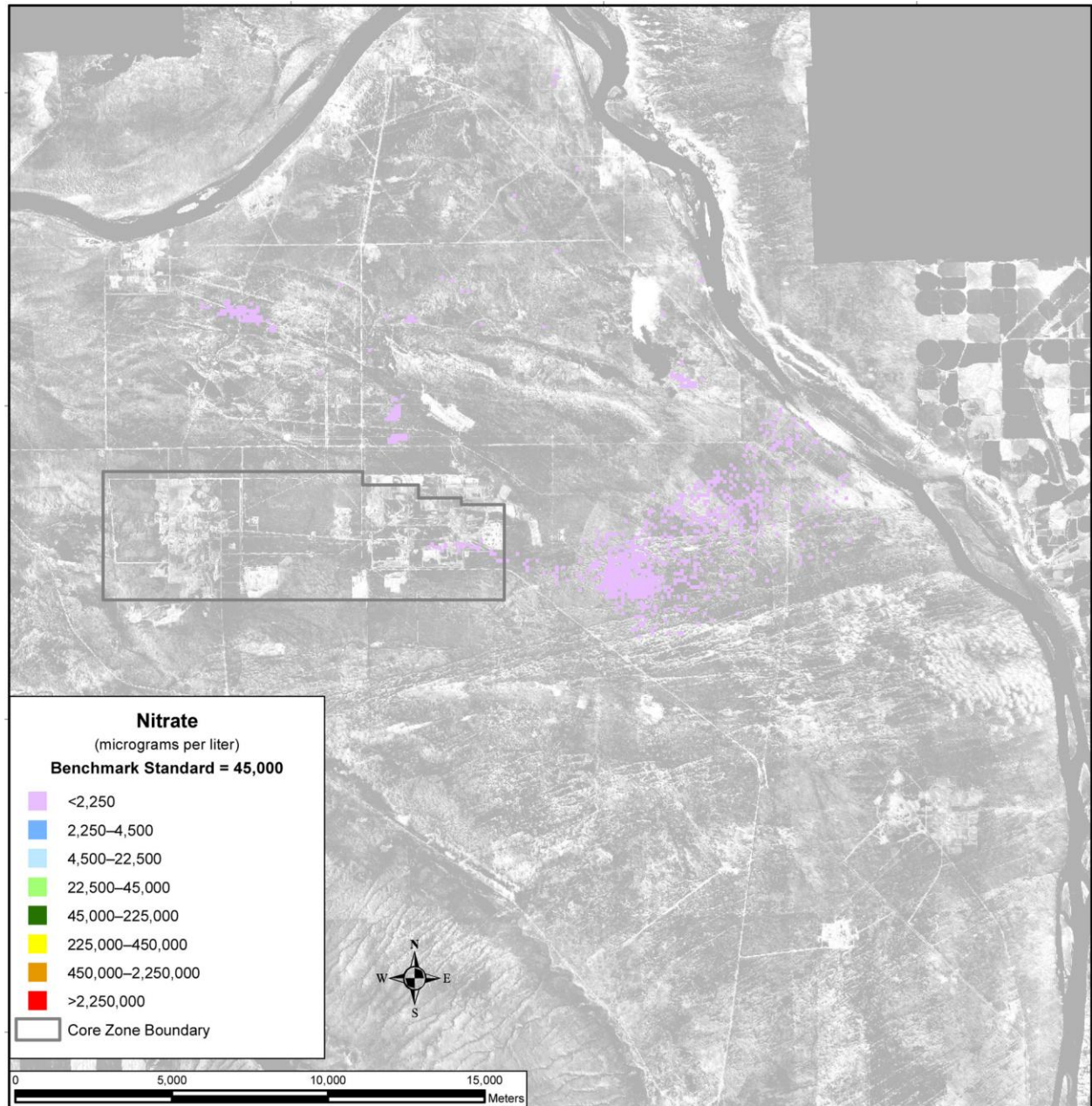
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1086. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1087. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1088. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

Total uranium shows a different spatial distribution over time. Uranium is not as mobile as those COPCs discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–1089 shows the distribution of total uranium in CY 11,885. Releases from the RPPDF result in a groundwater plume that starts in the Core Zone and moves north through Gable Gap. However, concentrations in this plume do not exceed the benchmark concentration during the period of analysis.

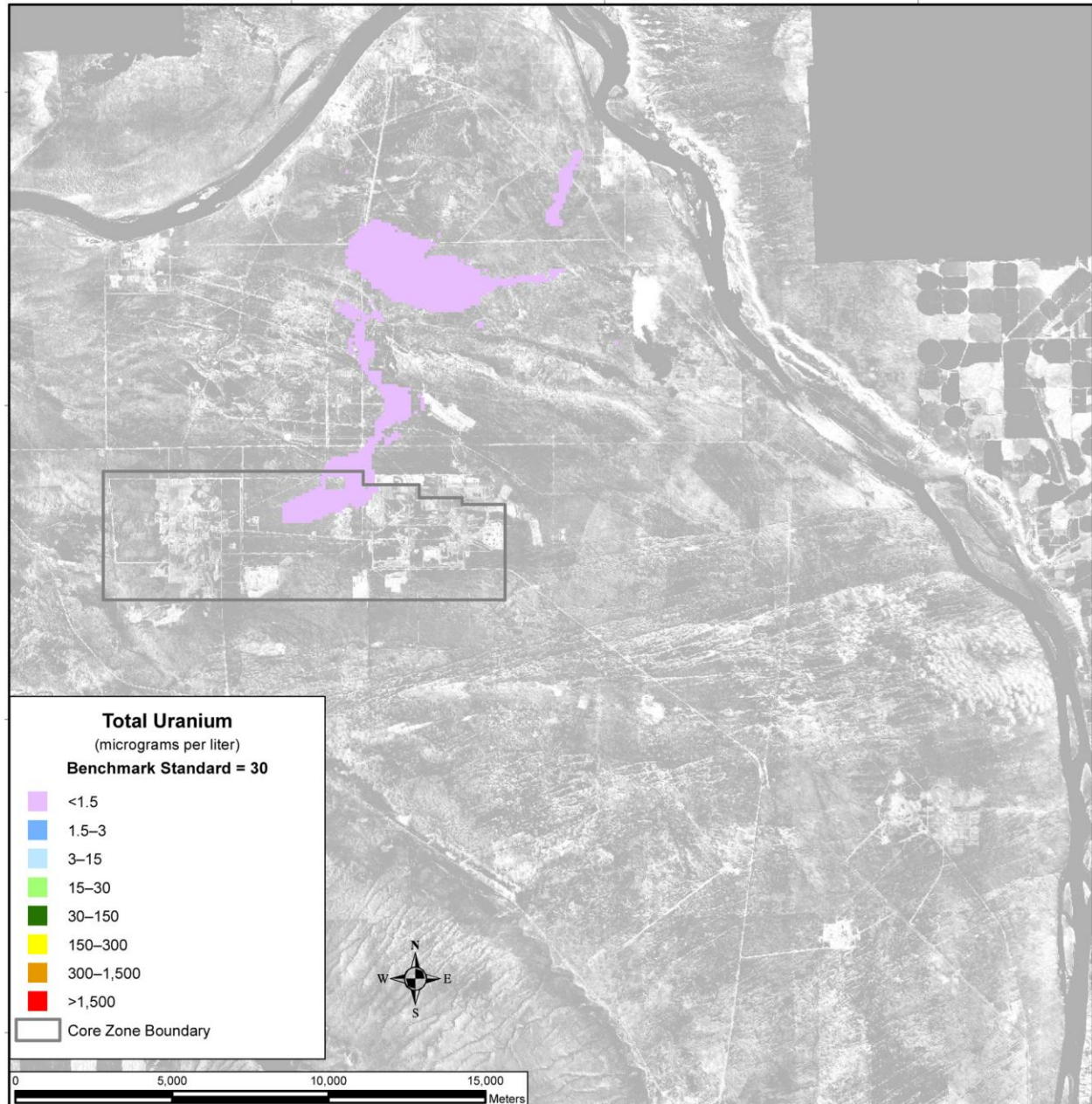


Figure 5–1089. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 3, Base Case, in general, the inventories remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For the conservative tracers, concentrations slightly outside the Core Zone Boundary exceed benchmark standards by one to two orders of magnitude during most of the period of analysis. Concentrations at the Columbia River are about one to two orders of magnitude smaller. The intensities and areas of these groundwater plumes peak between CYs 3890 and 7140.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentration of total uranium does not exceed the benchmark at the Core Zone Boundary or the Columbia River nearshore.

5.3.1.3.3.2 Disposal Group 3, Option Case

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 3, Option Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6A, Option Case, and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 3, Option Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2165, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.
- The post-disposal period was assumed to start in CY 2166 and continue through the 10,000-year period of analysis. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 3, Option Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 3, Option Case, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129, technetium-99, and uranium-238
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, nitrate, and total uranium

The COPC drivers for Waste Management Alternative 3, Disposal Group 3, Option Case, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. Uranium-238 and total uranium were added to the COPC drivers; although their contributions to risk and hazard are not dominant during the year of peak risk or hazard,

they become major contributors toward the end of the period of analysis. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for 100 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 3, Option Case.

The COPC drivers that are discussed in detail in this section fall into two categories. Iodine-129, technetium-99, chromium, and nitrate are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. Uranium-238 and total uranium are long-lived, or stable, but are not as mobile as the other COPC drivers. These constituents move about seven times more slowly than groundwater. As the analyses of release, concentration versus time, and spatial distribution of the COPC drivers are presented, the distinct behavior of these groups will become apparent.

The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Option Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Three subtotals are plotted in Figures 5–1090 through 5–1095, representing releases from IDF-East, which include ETF-generated secondary waste, PPF glass, retired melters, and tank closure secondary waste; releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste; and releases from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over seven orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–1090 shows the release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–1091, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., all of the inventory is released during the period of analysis). Tank closure secondary waste is the predominant source of technetium-99 and chromium. ETF-generated secondary waste is the predominant source of iodine-129 and nitrate.

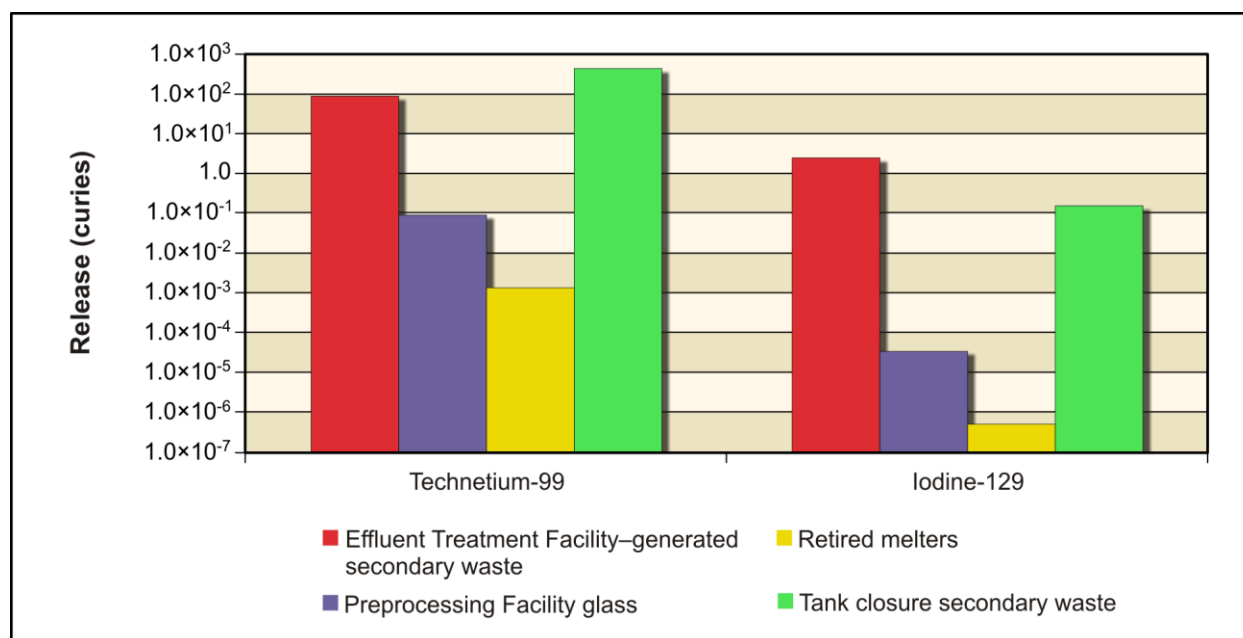


Figure 5-1090. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

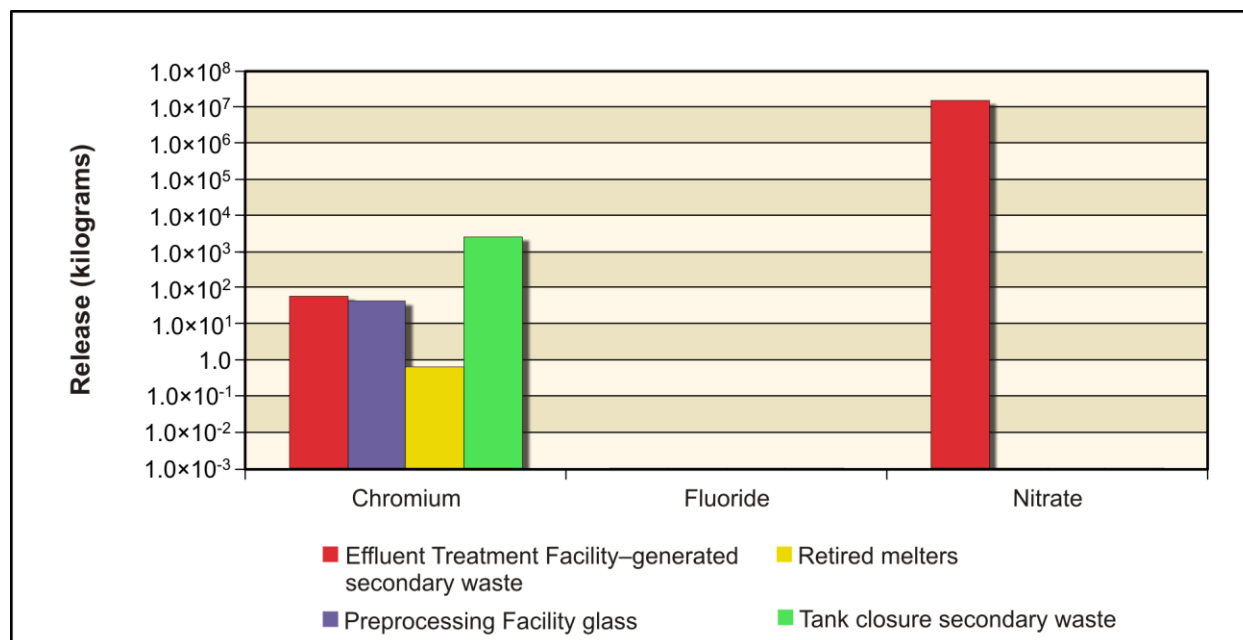


Figure 5-1091. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5-1092 shows the release from IDF-East to groundwater of the radiological risk drivers and Figure 5-1093, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Nearly all (92 percent) of the technetium-99 released from ETF-generated secondary waste to the vadose zone reaches groundwater during the period of analysis, but only 40 to 50 percent of the technetium-99 from other sources and iodine-129 released to the vadose zone reaches groundwater. Only 45 to 50 percent of the chromium from PPF glass and retired melters reaches groundwater. Essentially all (99 percent) of the chromium

released from ETF-generated secondary waste and tank closure secondary waste reaches groundwater. Nearly all (greater than 99 percent) nitrate released to the vadose zone reaches groundwater.

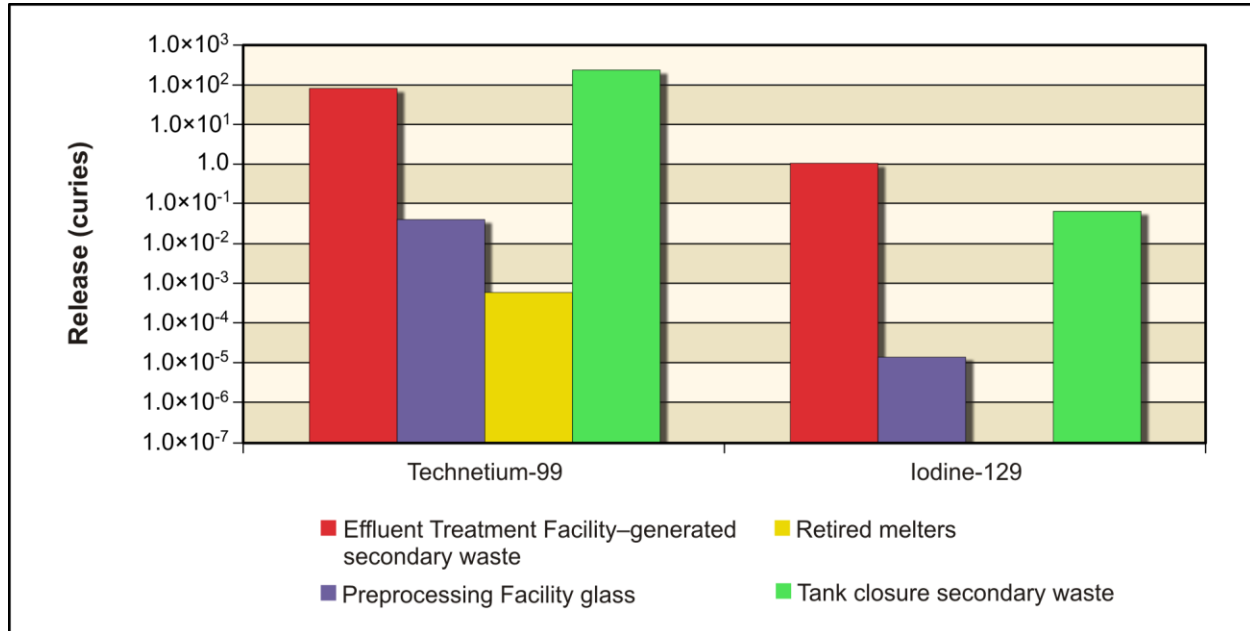


Figure 5–1092. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

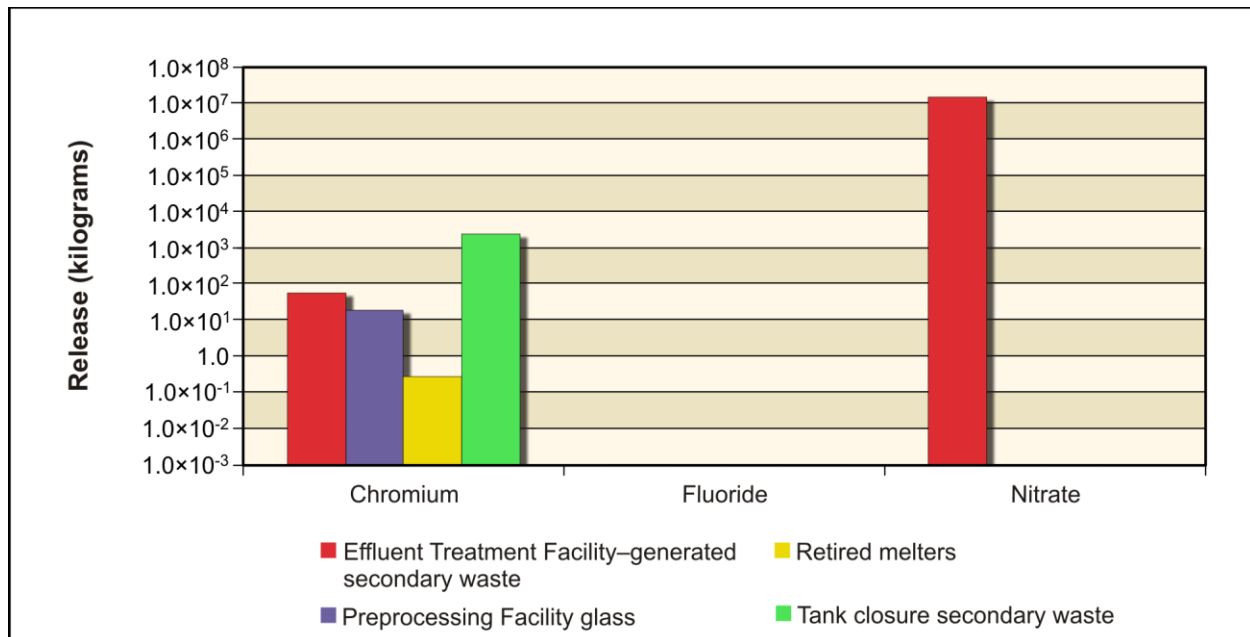


Figure 5–1093. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–1094 shows the release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–1095, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In all cases, between 90 and 100 percent of the amount released to groundwater reaches the Columbia River.

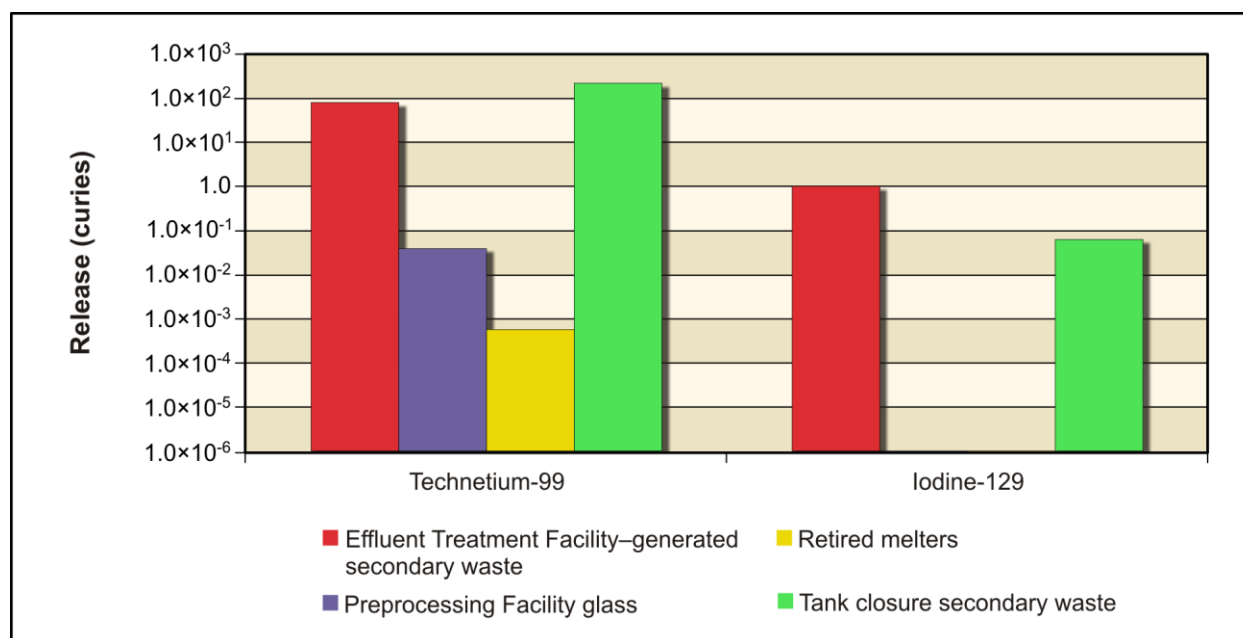


Figure 5-1094. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

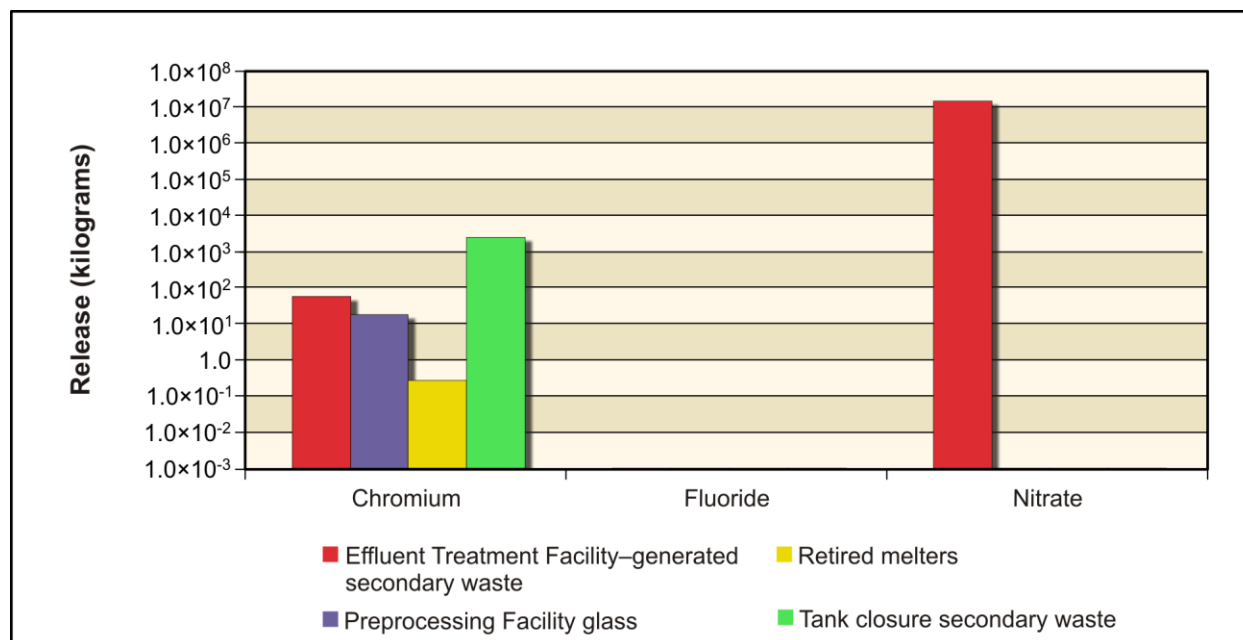


Figure 5-1095. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Figure 5-1096 shows the release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5-1097, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present in IDF-West.

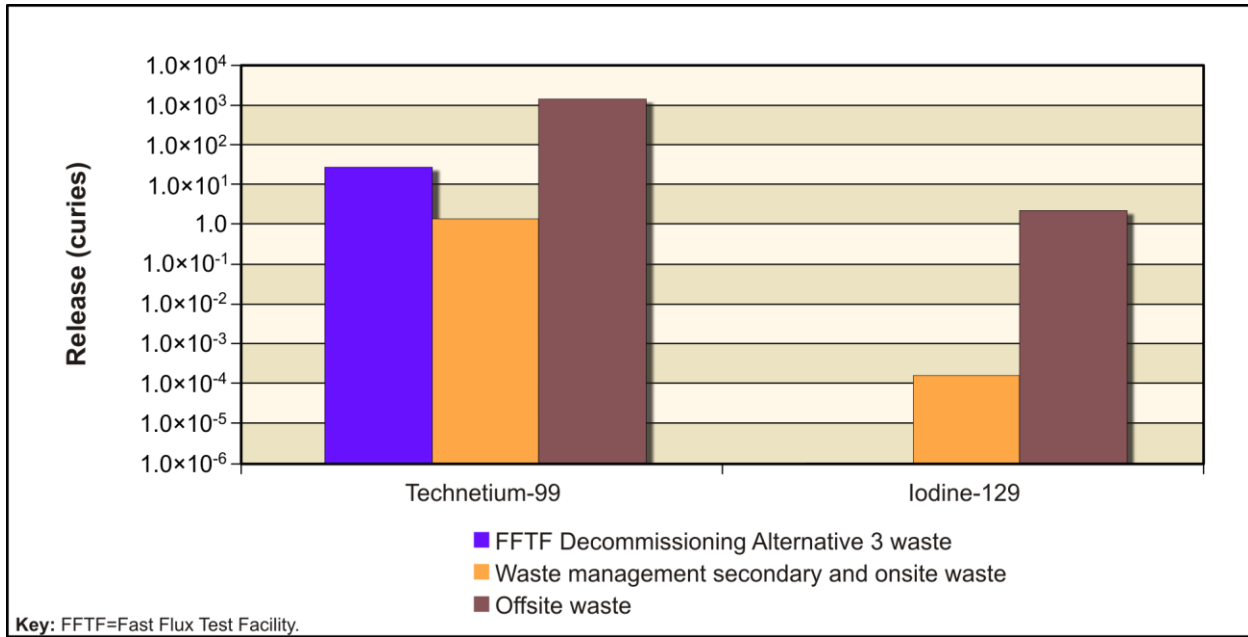


Figure 5–1096. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

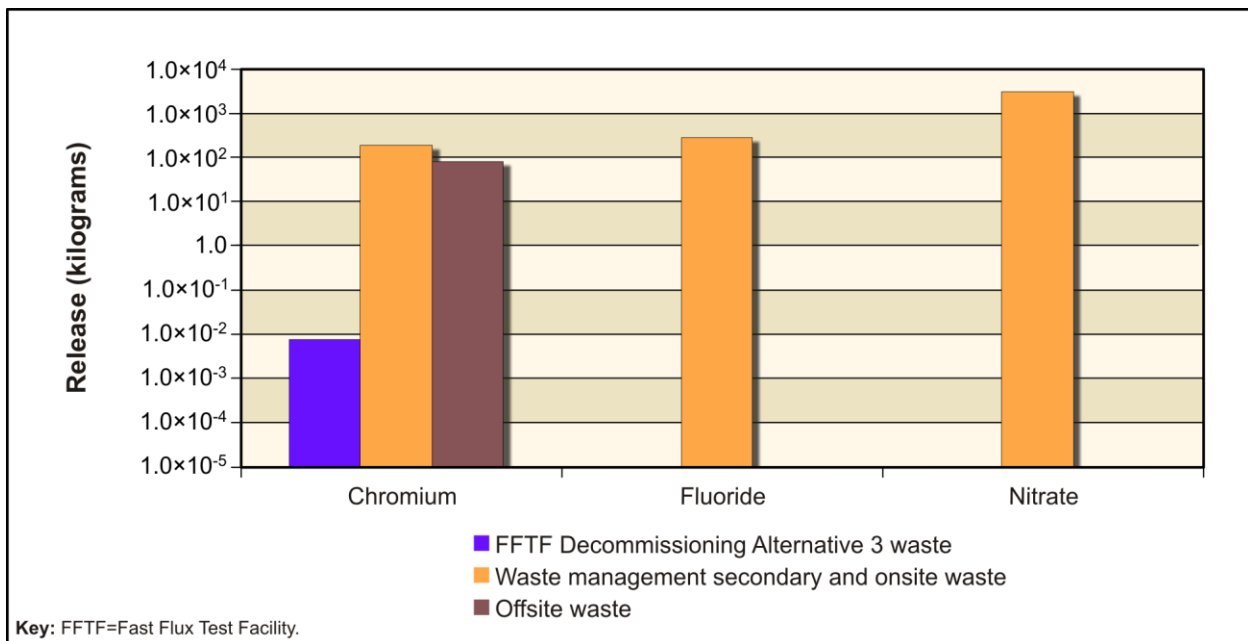


Figure 5–1097. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–1098 shows the release from IDF-West to groundwater of the radiological risk drivers and Figure 5–1099, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present in IDF-West behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

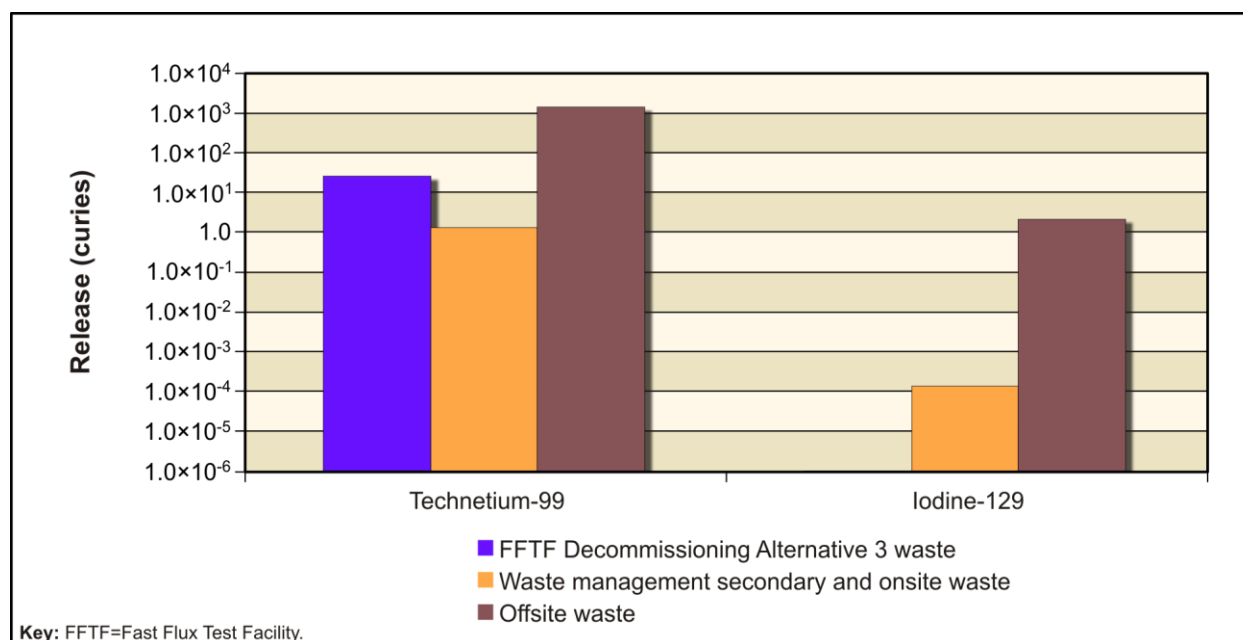


Figure 5–1098. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

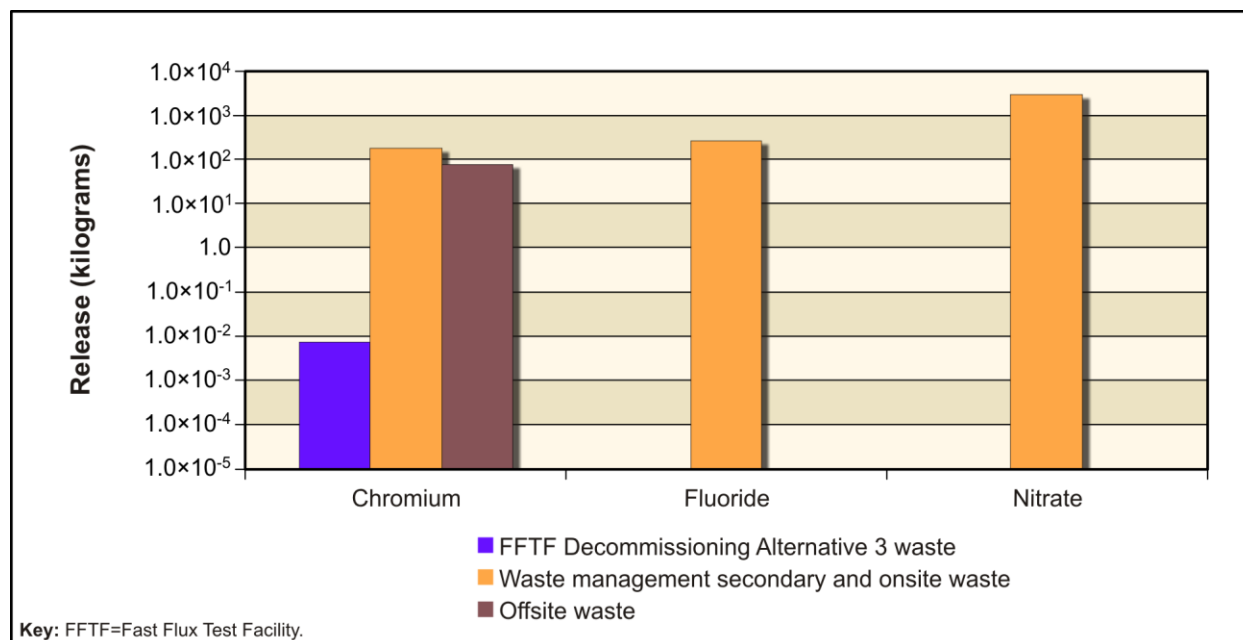


Figure 5–1099. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–1100 shows the release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–1101, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially all of the COPC drivers released to groundwater reach the Columbia River.

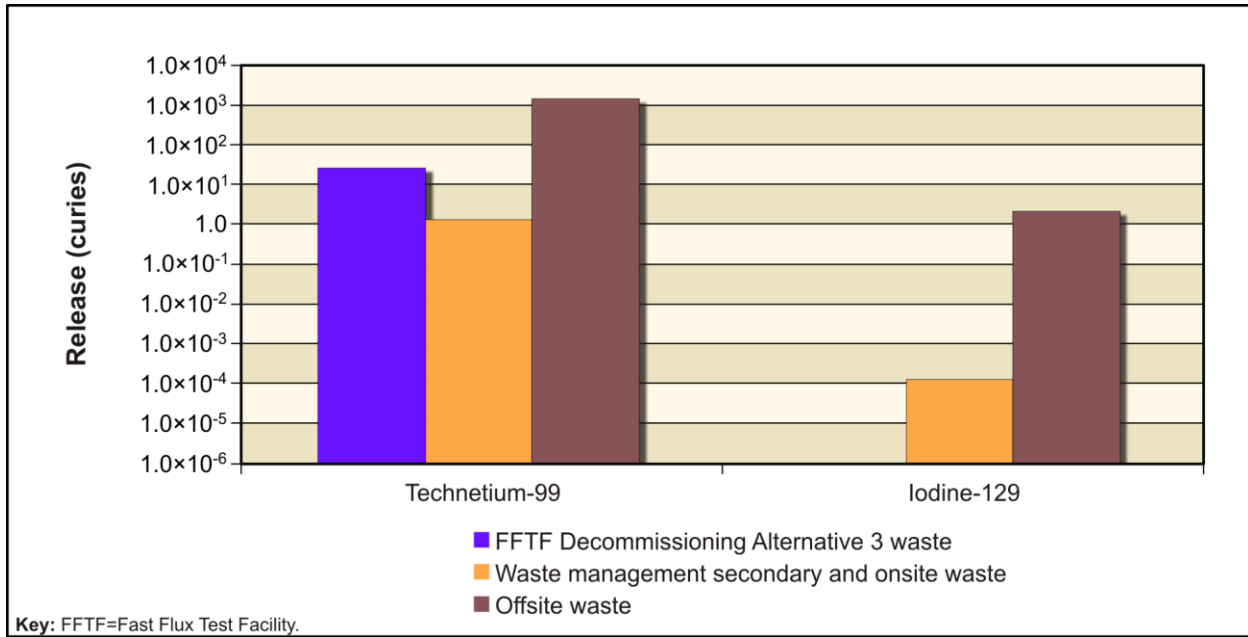


Figure 5–1100. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

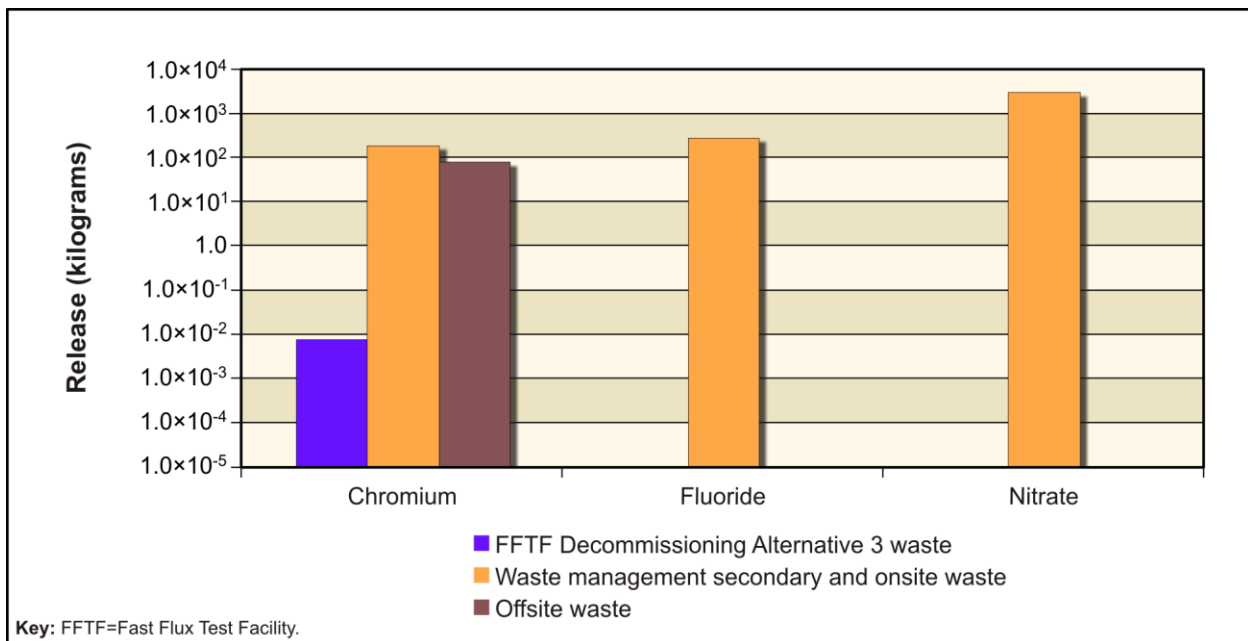


Figure 5–1101. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–1102 shows the release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–1103, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF.

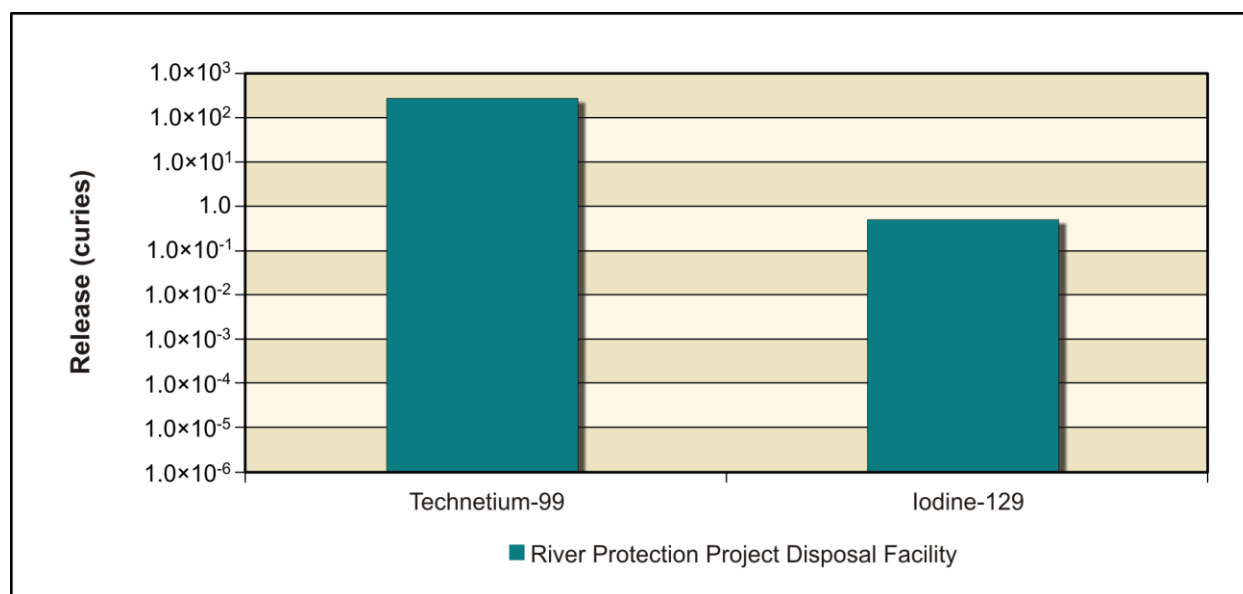


Figure 5–1102. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

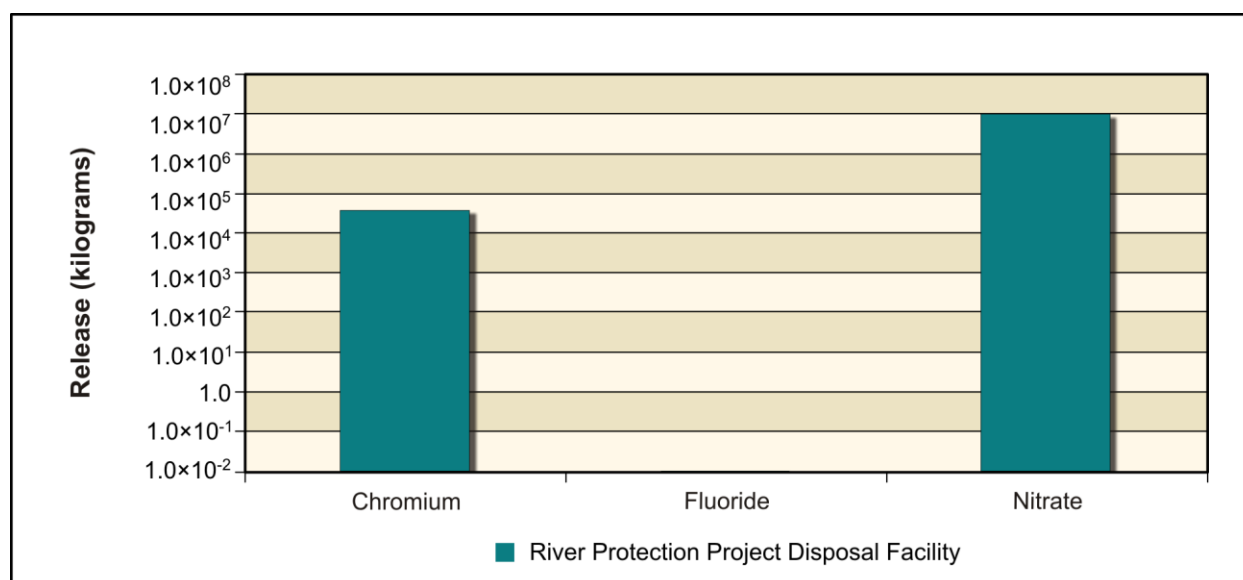


Figure 5–1103. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–1104 shows the release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–1105, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

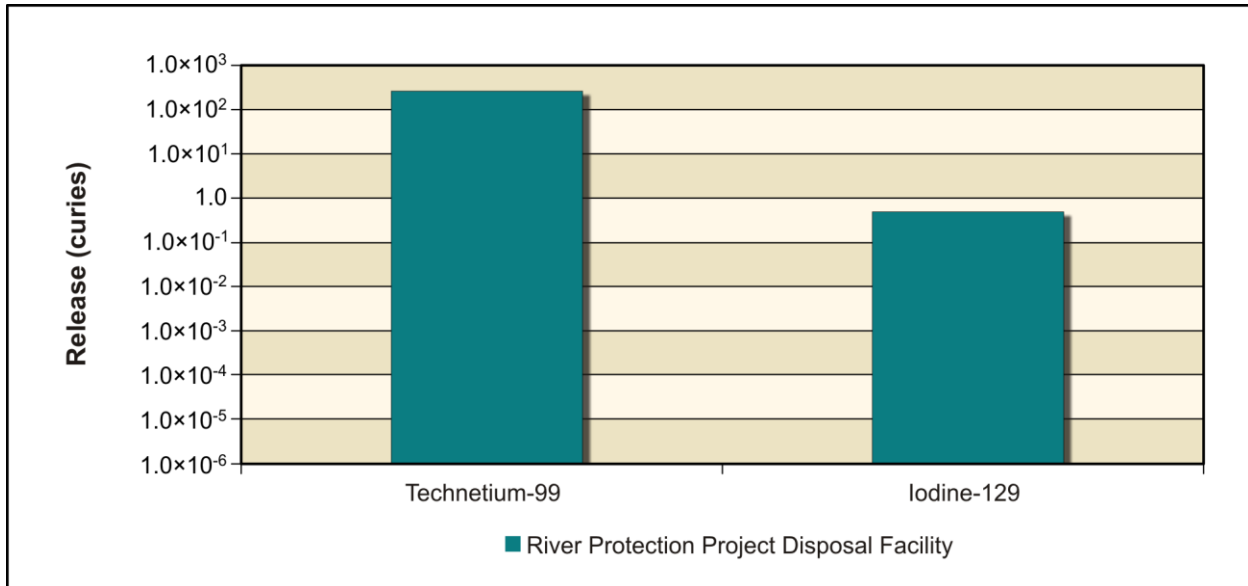


Figure 5–1104. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

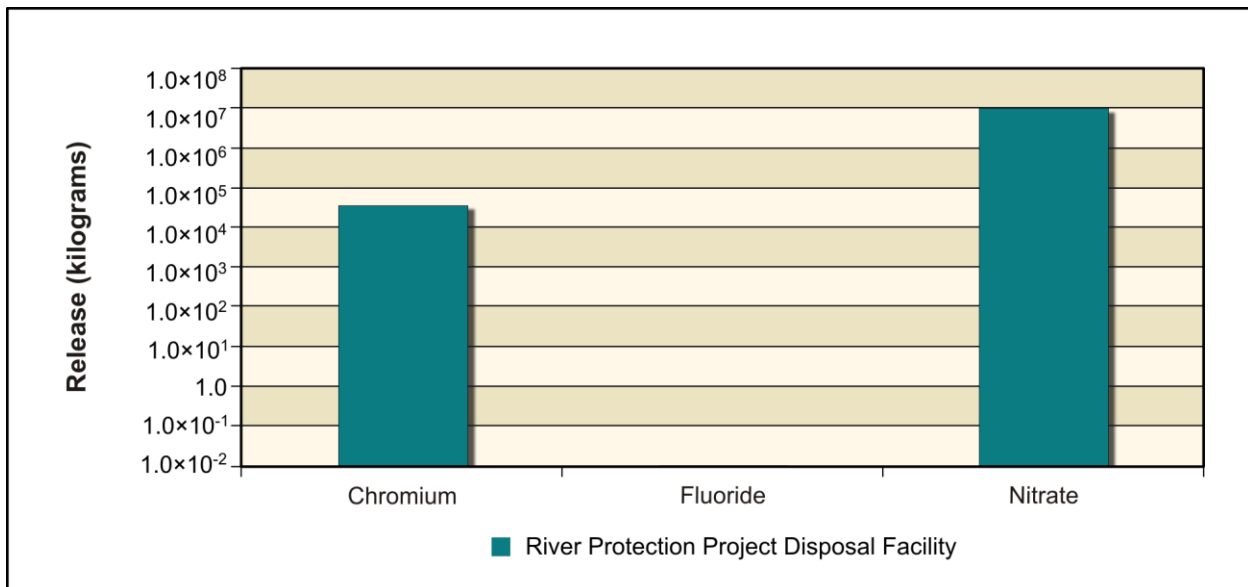


Figure 5–1105. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–1106 shows the release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–1107, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially all of the COPC drivers released to groundwater reach the Columbia River.

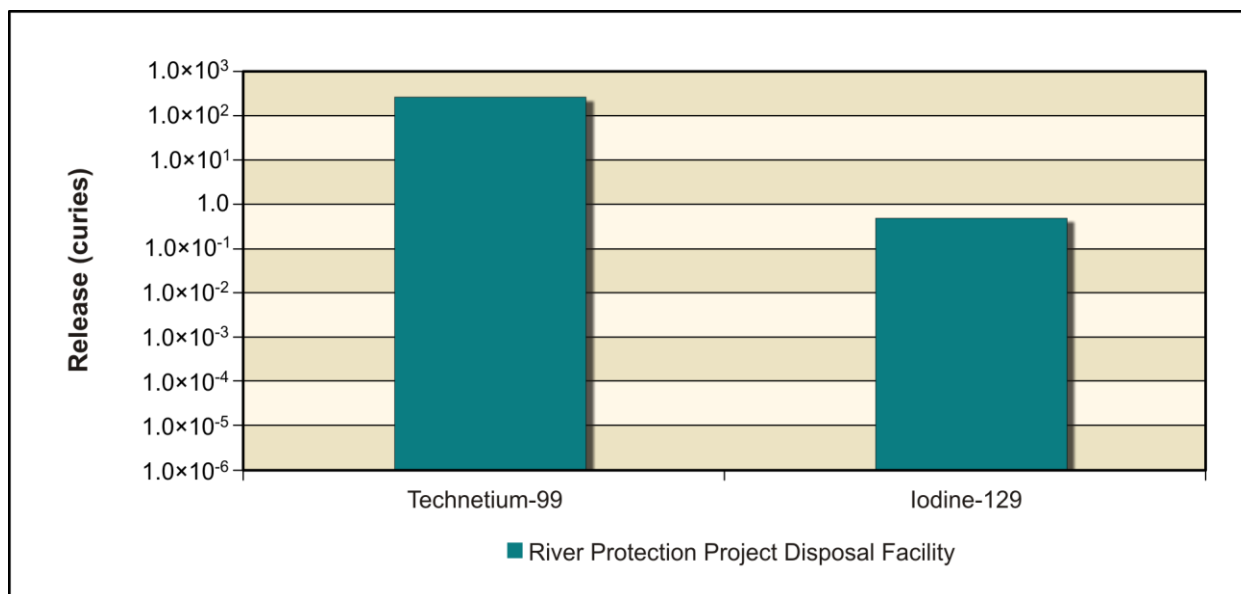


Figure 5–1106. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

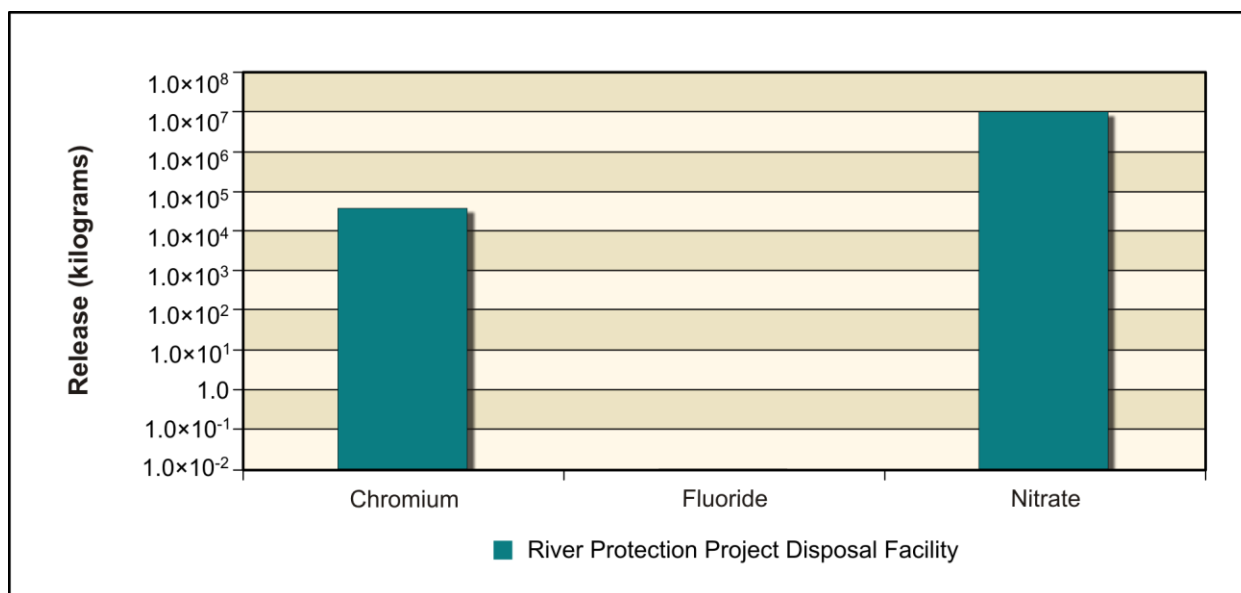
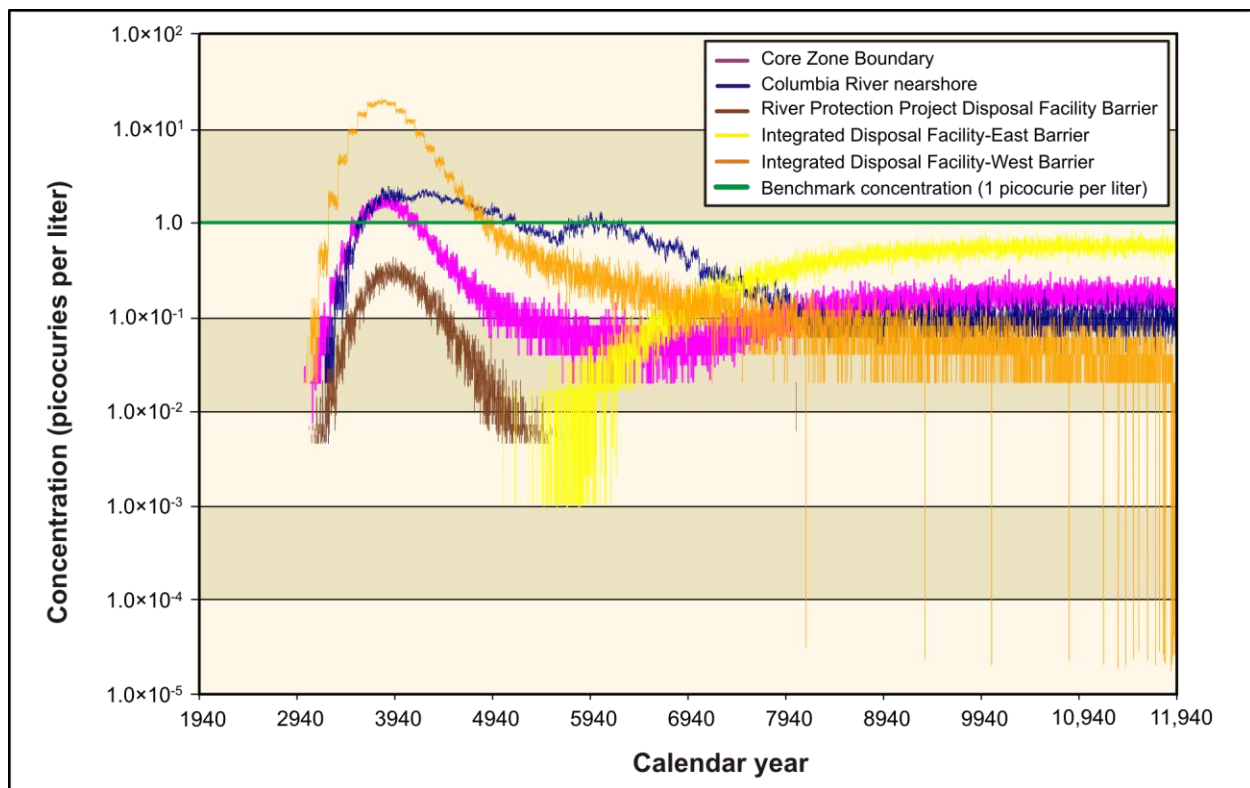


Figure 5–1107. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Option Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figures 5–1108 through 5–1111 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). For technetium-99, concentrations at the IDF-West barrier and Core Zone Boundary rise early in the simulation, reaching a peak around CY 3940. Technetium-99 concentrations are about one order of magnitude greater than the benchmark concentration at the IDF-West barrier and are approximately equal to the benchmark concentration at the Core Zone Boundary and Columbia River nearshore. Concentrations then slowly decline to between one and two orders of magnitude below the benchmark. The technetium-99 release from IDF-East occurs later and levels off at about one order of magnitude below the benchmark concentration. Iodine-129 follows a pattern similar to that of technetium-99, with concentrations falling slightly below the benchmark after peaking from one to two orders of magnitude above the benchmark. Chromium and nitrate also follow a similar pattern, with an early peak in concentrations at the Core Zone Boundary, followed by a slow decline. Both chromium and nitrate concentrations (at the Core Zone Boundary) approach within one order of magnitude of the benchmark concentration for most of the analysis period. Note that the actual time periods of exceedance associated with the peak values (listed in Table 5–117) are extremely limited. Table 5–117 shows the maximum concentrations in groundwater. Exceedances of the benchmark values occur primarily at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where technetium-99 and iodine-129 concentrations are highest. At the IDF-East barrier, maximum iodine-129 concentrations approach the benchmark concentration in CY 11,811. None of the other COPC benchmark concentrations were exceeded during the simulation.



**Figure 5–1108. Waste Management Alternative 3, Disposal Group 3, Option Case,
Iodine-129 Concentration Versus Time**

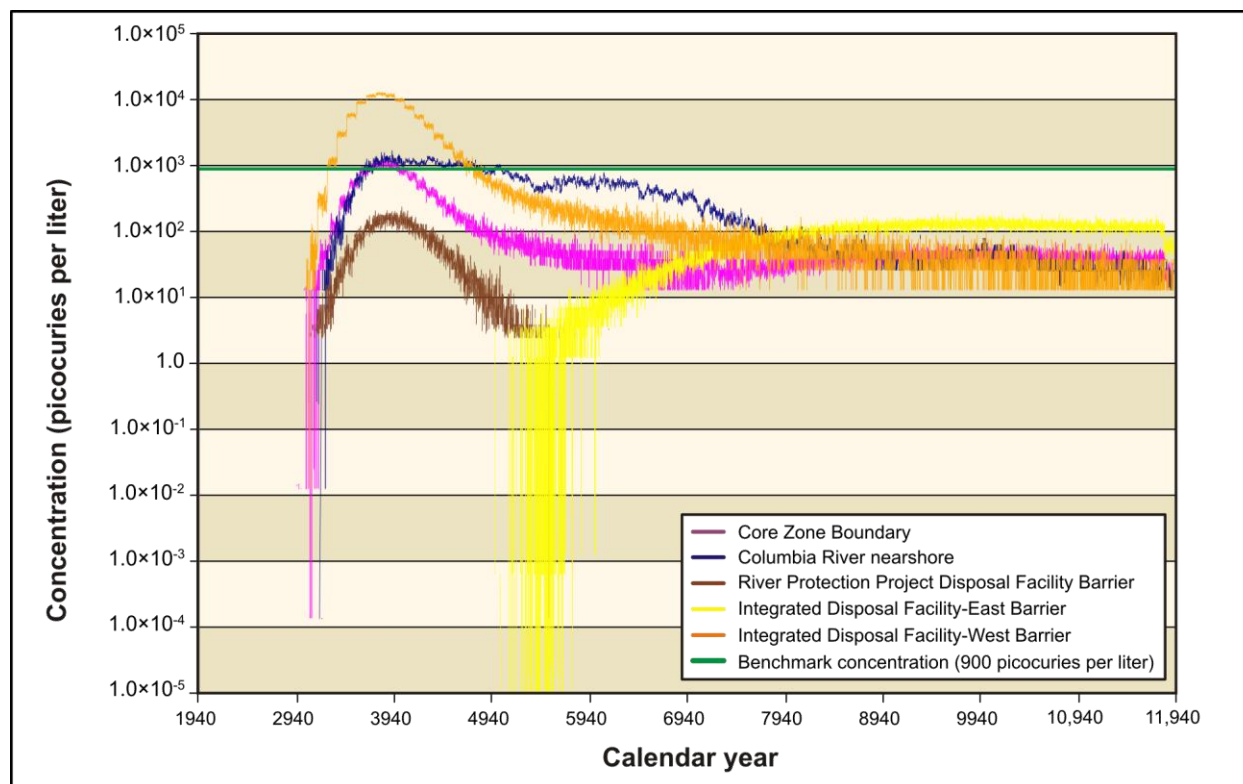


Figure 5–1109. Waste Management Alternative 3, Disposal Group 3, Option Case, Tchnetium-99 Concentration Versus Time

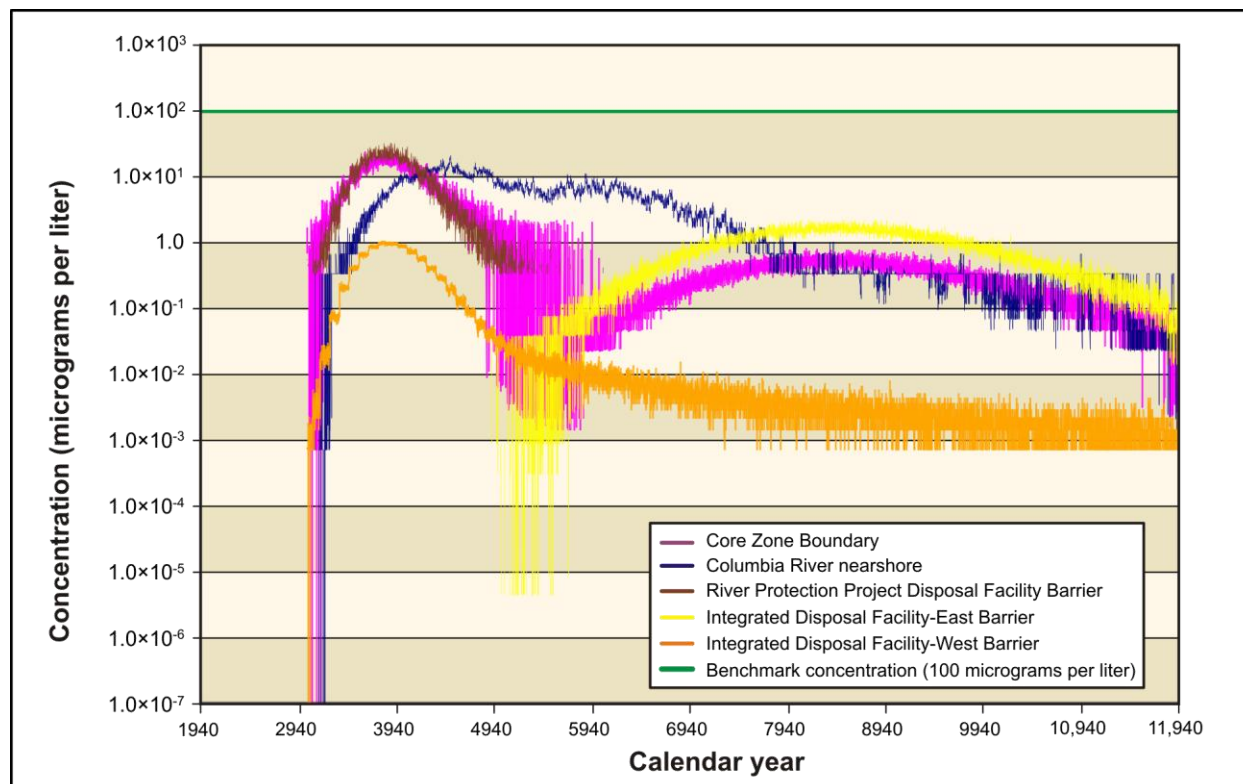
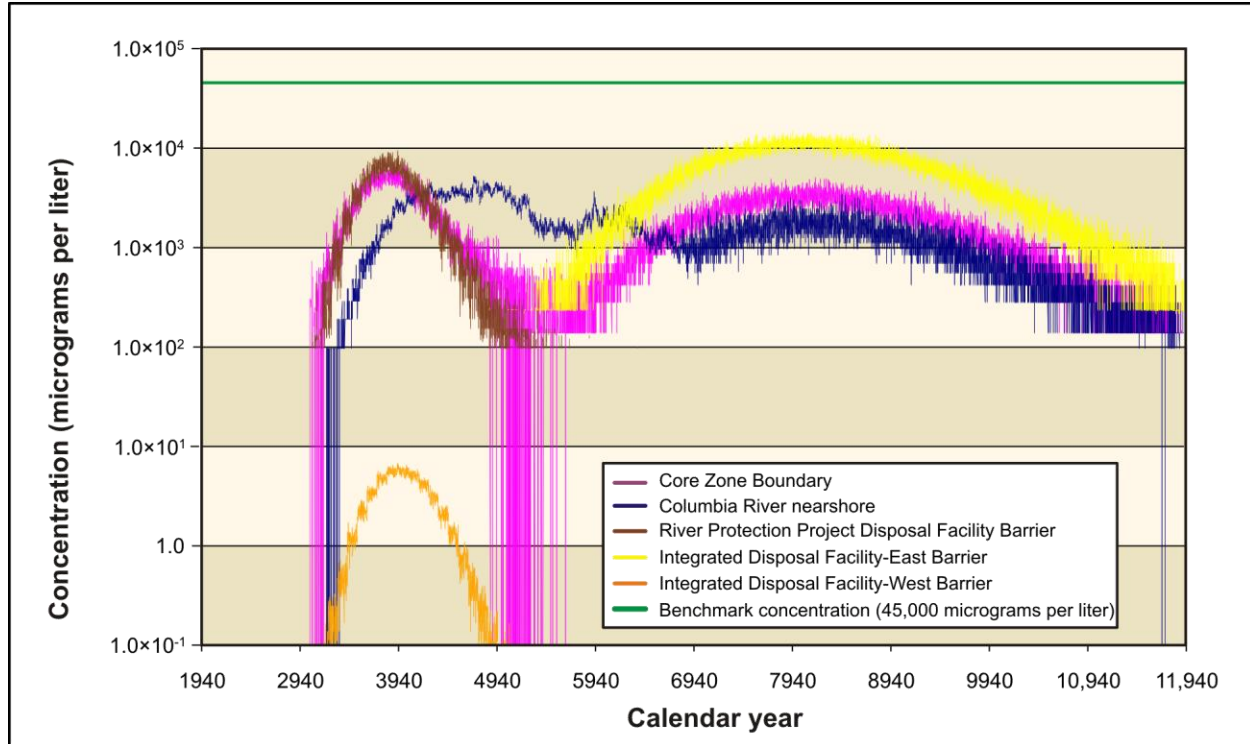


Figure 5–1110. Waste Management Alternative 3, Disposal Group 3, Option Case, Chromium Concentration Versus Time



**Figure 5-1111. Waste Management Alternative 3, Disposal Group 3, Option Case,
Nitrate Concentration Versus Time**

**Table 5-117. Waste Management Alternative 3, Disposal Group 3, Option Case,
Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF,
Core Zone Boundary, and Columbia River Nearshore**

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	196 (9705)	13,200 (3818)	235 (4018)	1,370 (3859)	1,670 (3920)	900
Iodine-129	0.9 (11,811)	20.6 (3794)	0.4 (3919)	2.1 (3937)	2.4 (3872)	1
Chemical (micrograms per liter)						
Chromium	2 (8501)	1 (3813)	32 (3873)	28 (3865)	21 (4487)	100
Fluoride	0 (1940)	1 (4014)	0 (3983)	0 (3937)	0 (4307)	4,000
Nitrate	14,600 (7954)	7 (3937)	9,270 (3930)	7,820 (3782)	5,190 (4701)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figure 5-1112 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until approximately CY 7940, when total uranium concentrations at

the Core Zone Boundary first surpass 1.0×10^{-8} micrograms per liter. Total uranium remains three orders of magnitude below the benchmark throughout the simulation. Total uranium remains over six orders of magnitude below the benchmark concentration at the RPPDF barrier and Core Zone Boundary throughout the 10,000-year period of analysis.

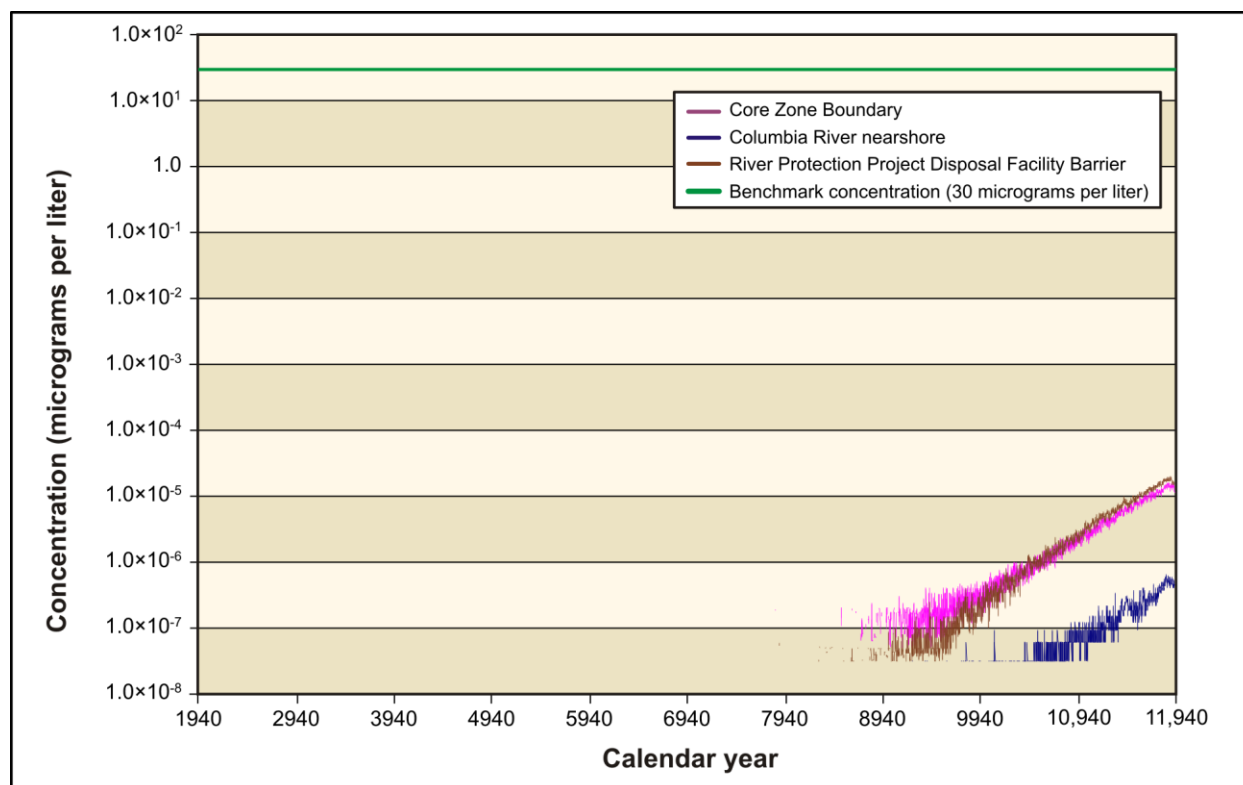


Figure 5–1112. Waste Management Alternative 3, Disposal Group 3, Option Case, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Option Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

In CY 3890 (see Figure 5–1113), there is a high-concentration plume of iodine-129 stretching northeast of IDF-West and a low-concentration plume stretching north from the RPPDF through Gable Gap. Four separate high-concentration areas have also formed north of Gable Mountain and Gable Butte. By CY 7140 (see Figure 5–1114), the plumes from IDF-West and the RPPDF have dissipated, but a new plume has formed, traveling east from IDF-East. Figure 5–1115 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 11,885. Concentrations in the IDF-East plume remain close to the benchmark. Technetium-99 (see Figures 5–1116 through 5–1118) shows a similar spatial distribution, but has lower concentrations relative to the benchmark value. Chromium and nitrate (see Figures 5–1119 through 5–1121 and Figures 5–1122 through 5–1124) show similar spatial distributions at

selected times, but have concentrations consistently well below the benchmark after CY 3890. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).

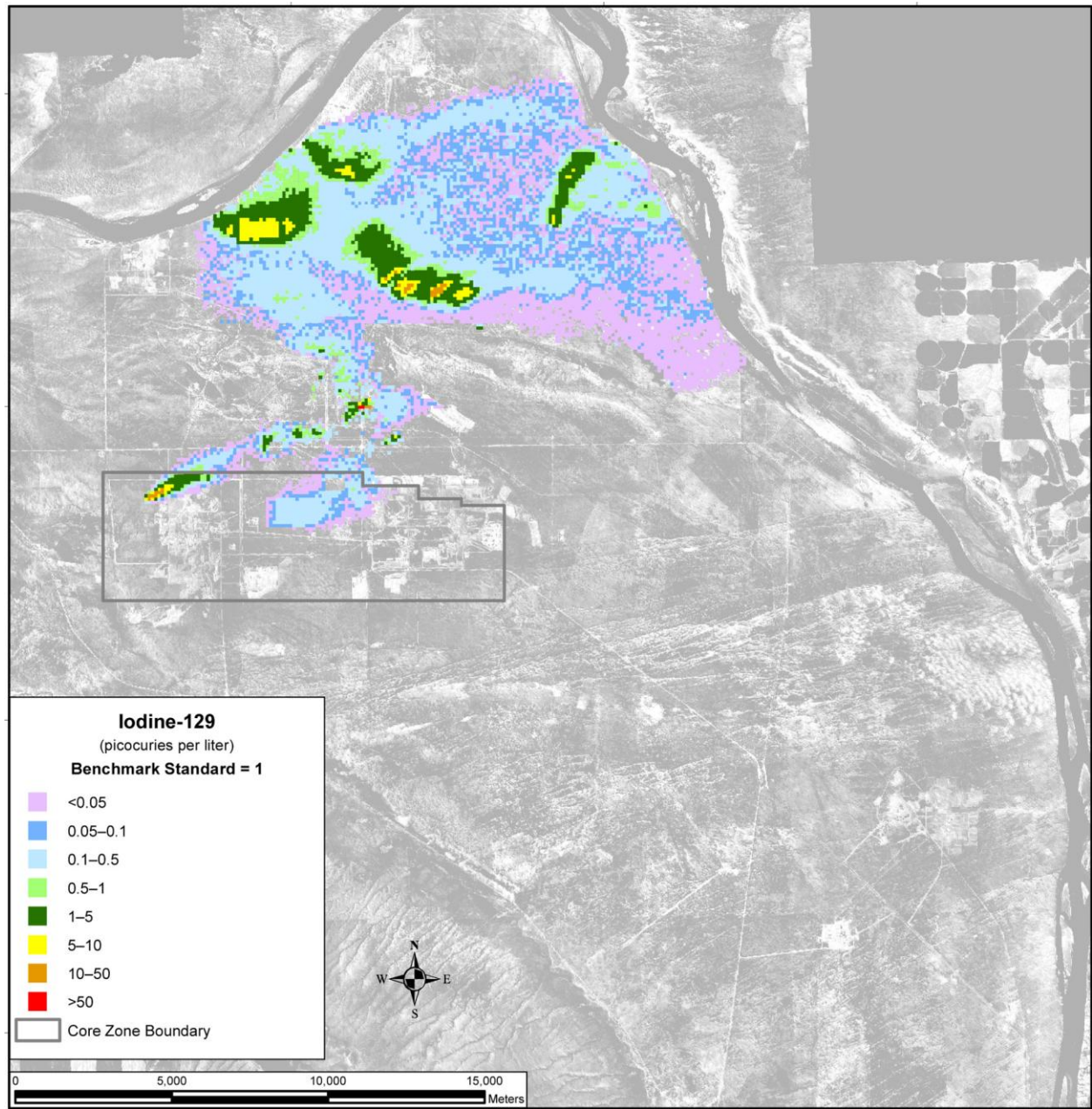
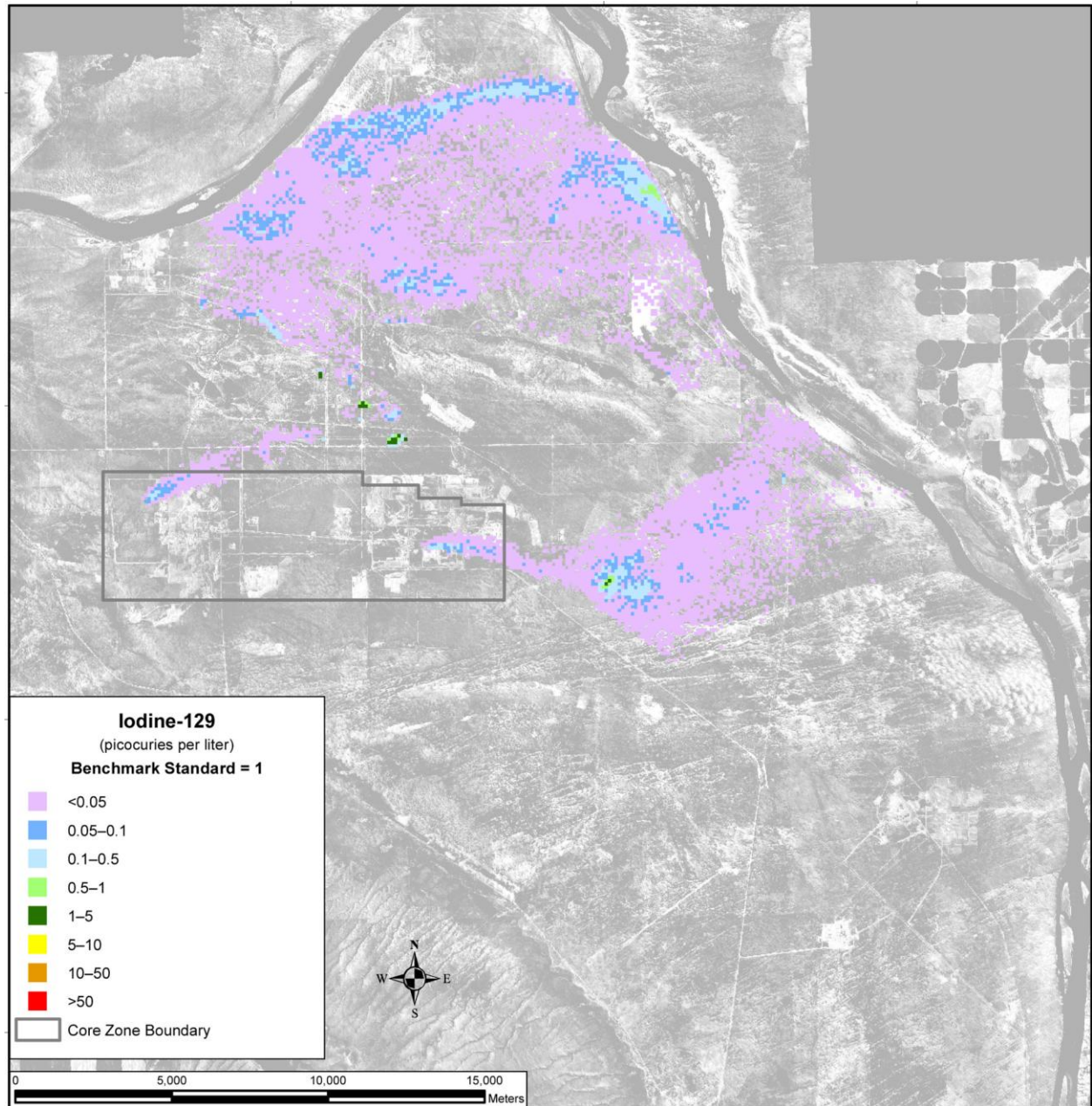
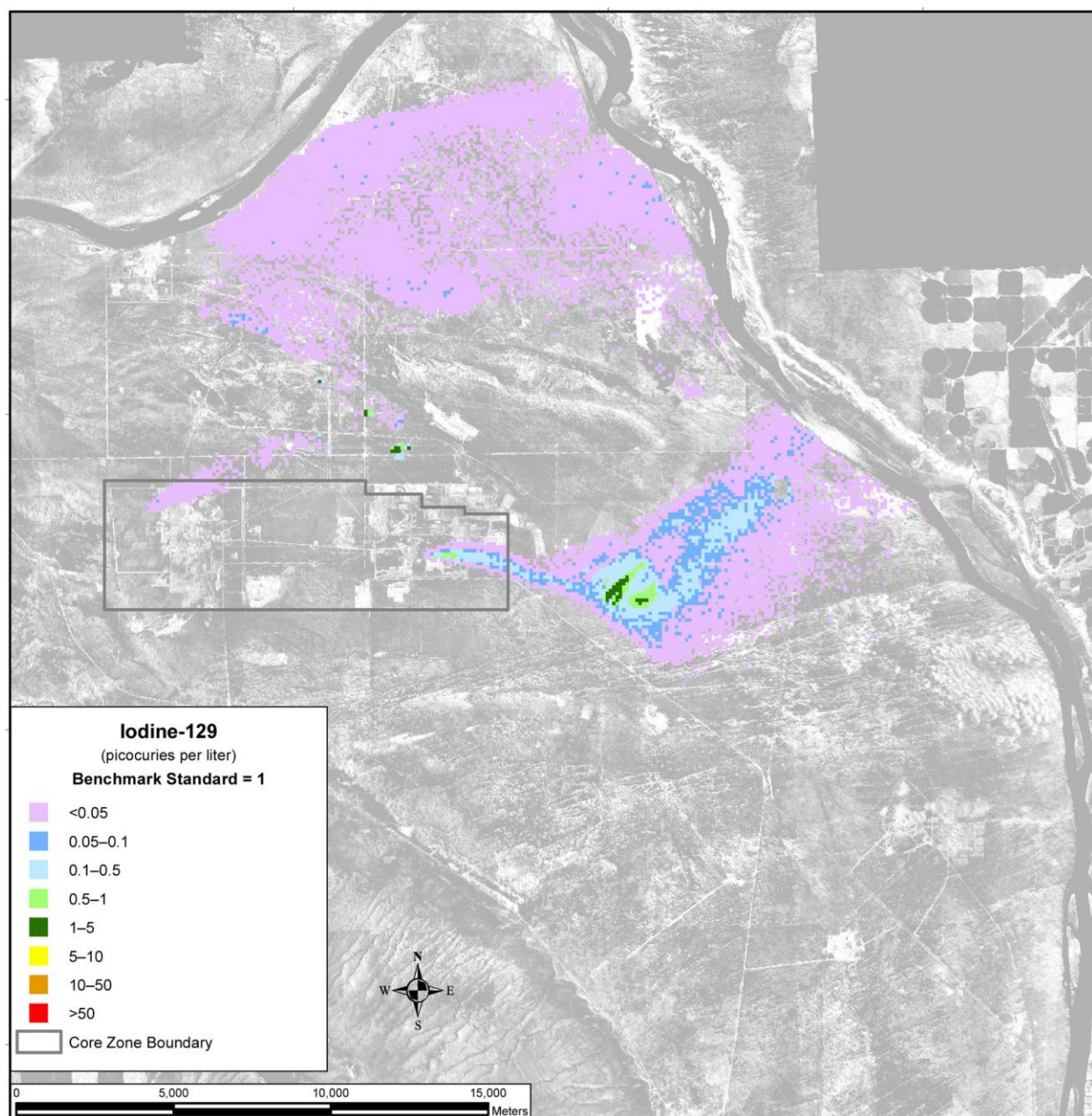


Figure 5–1113. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



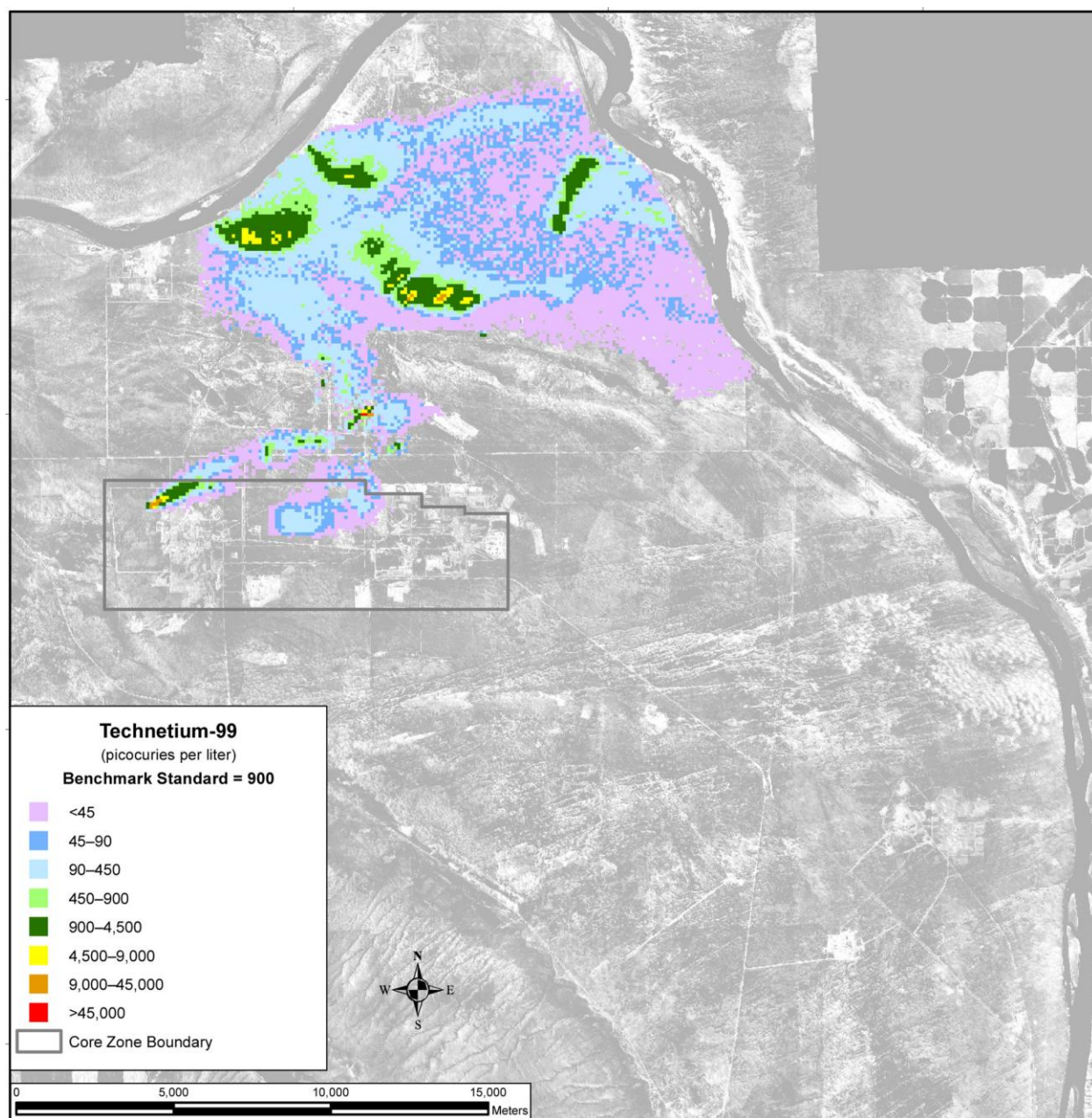
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1114. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5-1115. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1116. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890

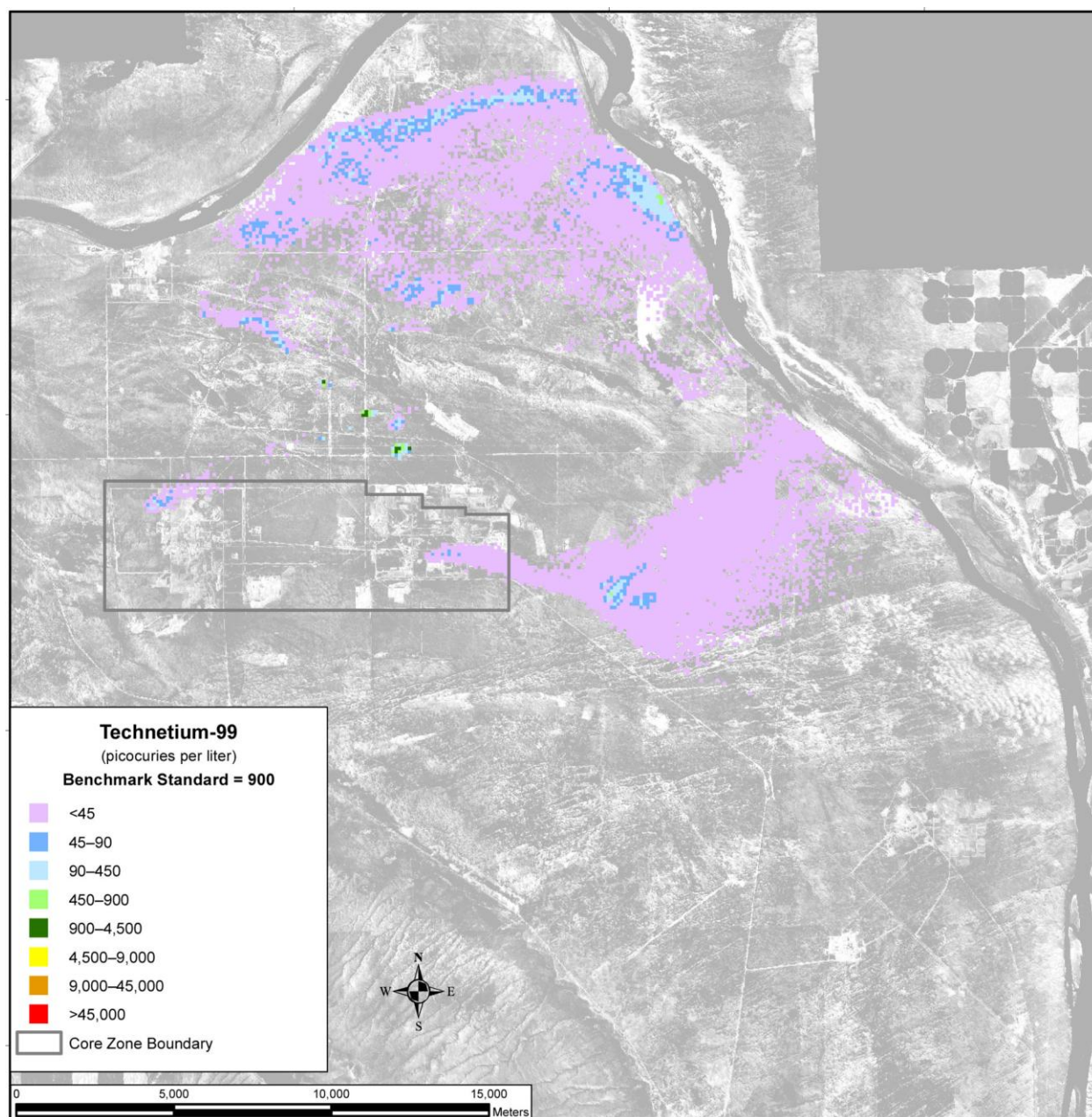
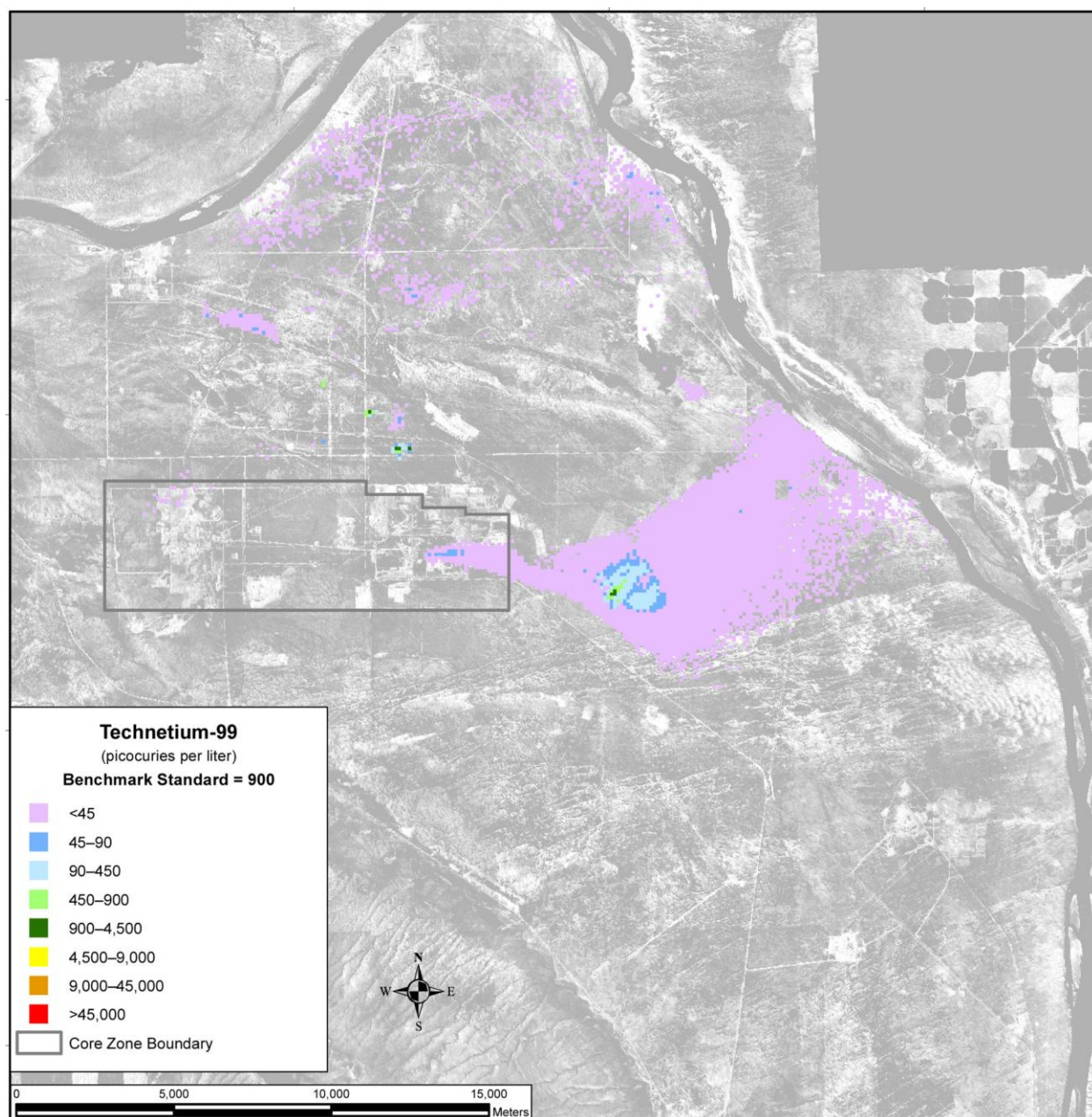


Figure 5–1117. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1118. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885

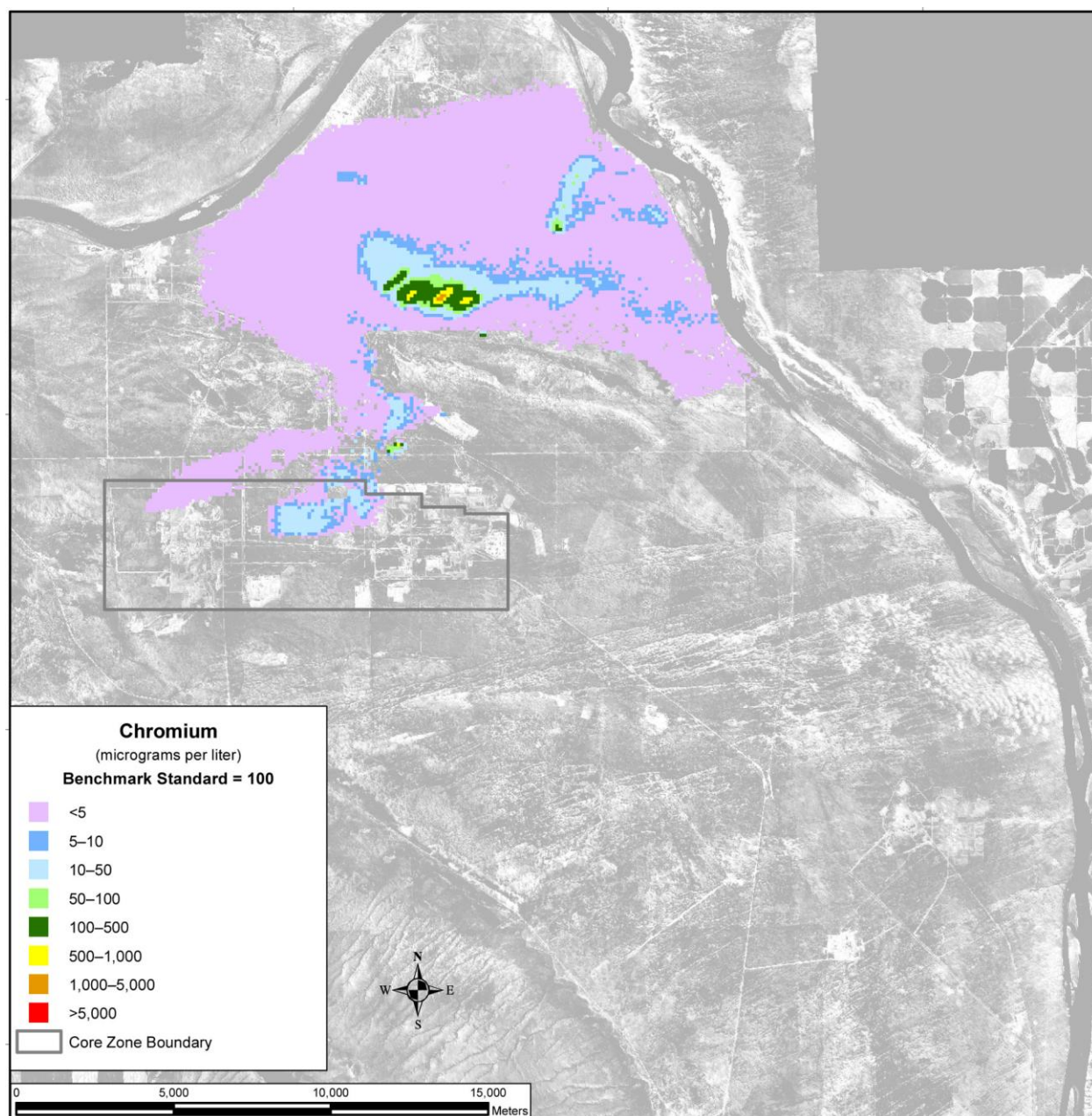
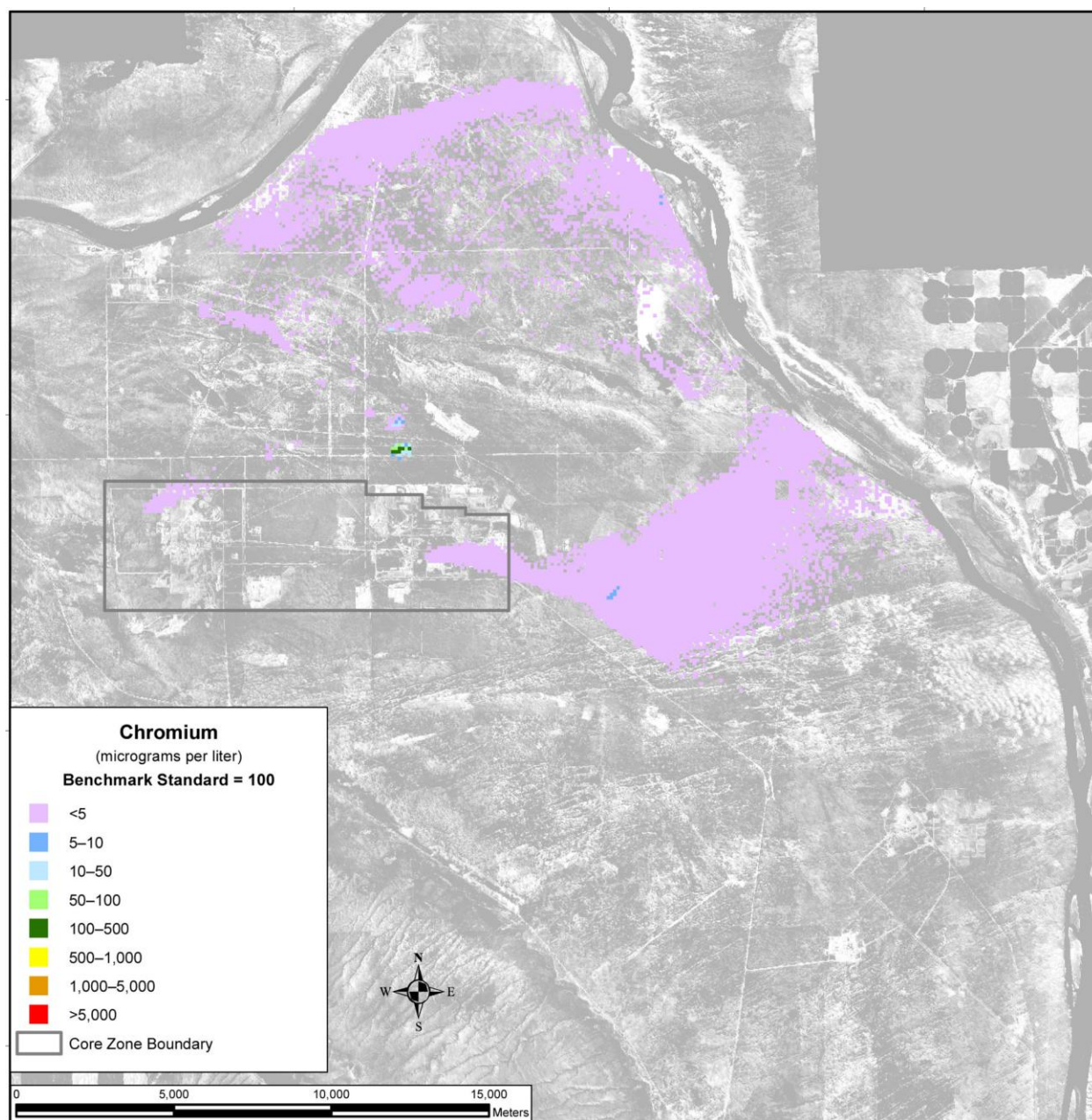


Figure 5–1119. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1120. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140

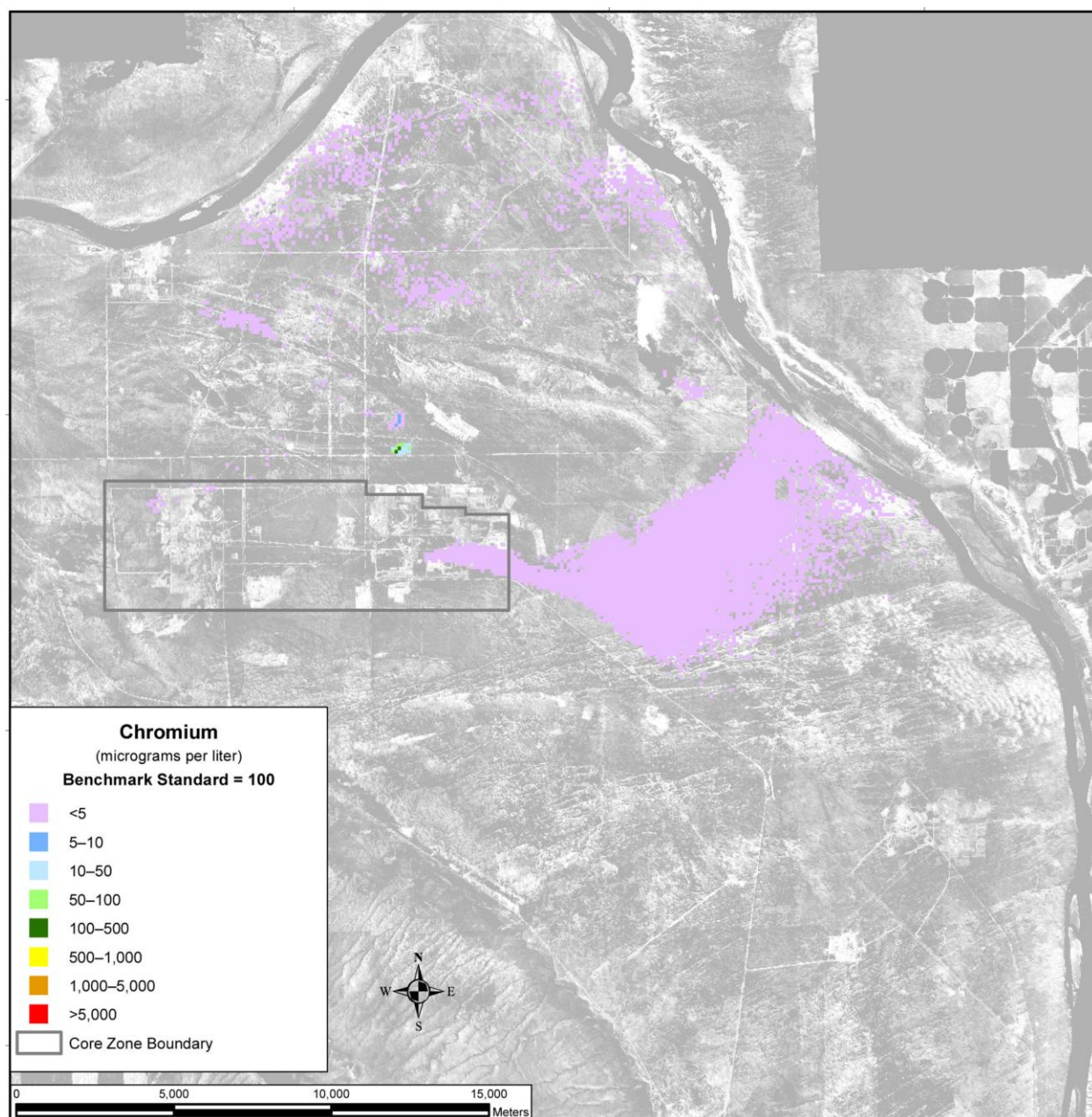
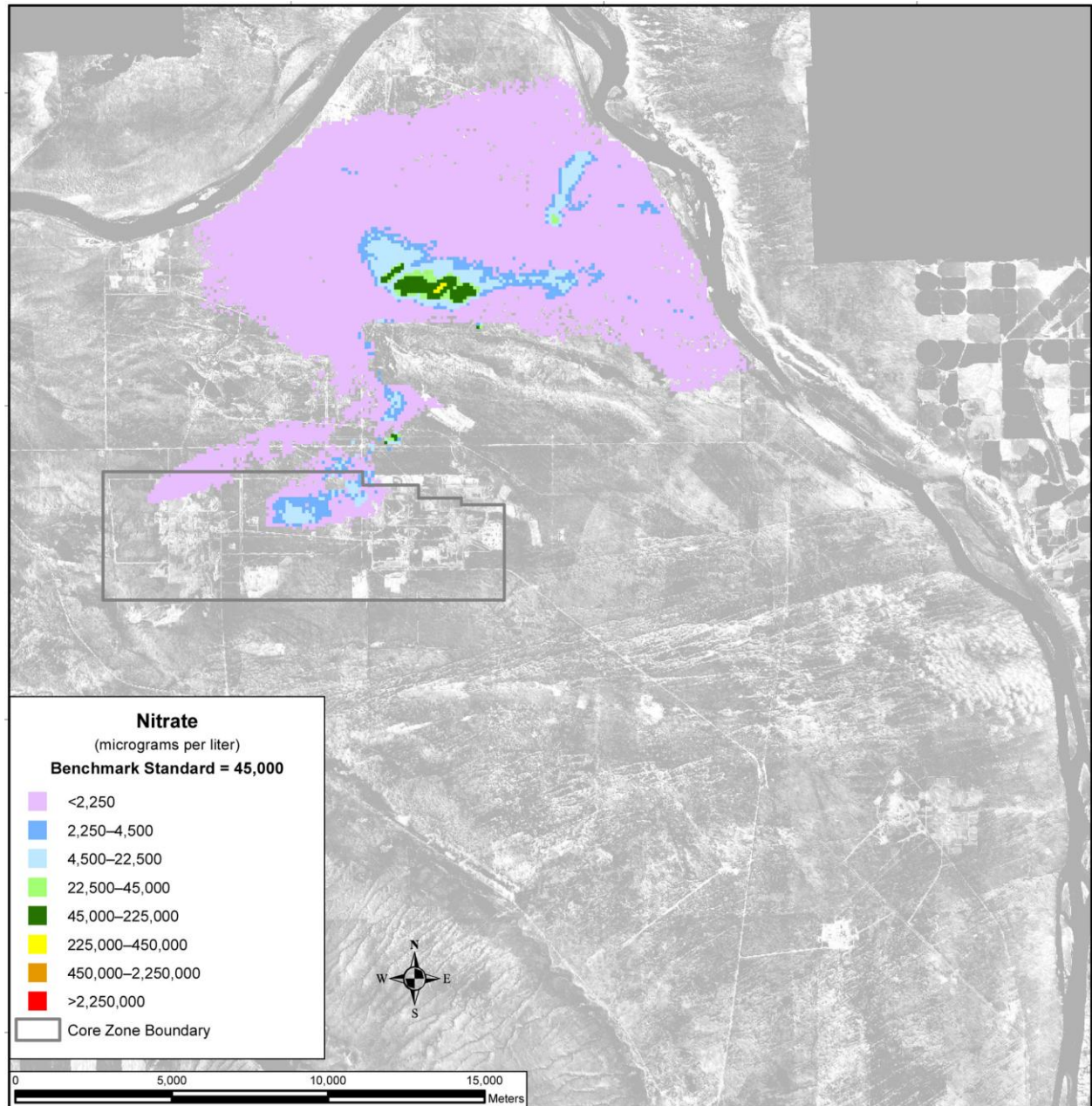


Figure 5–1121. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1122. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890

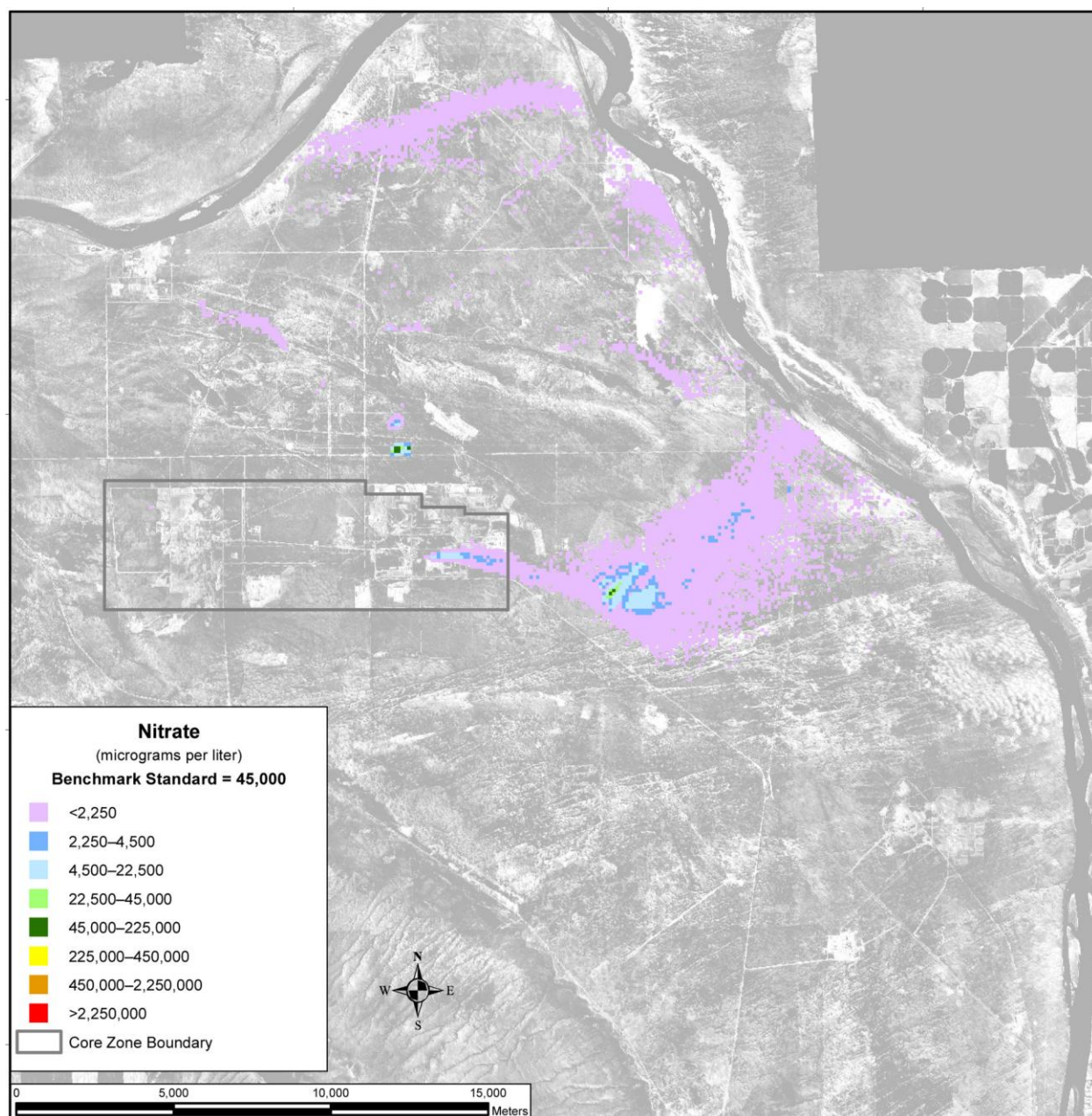
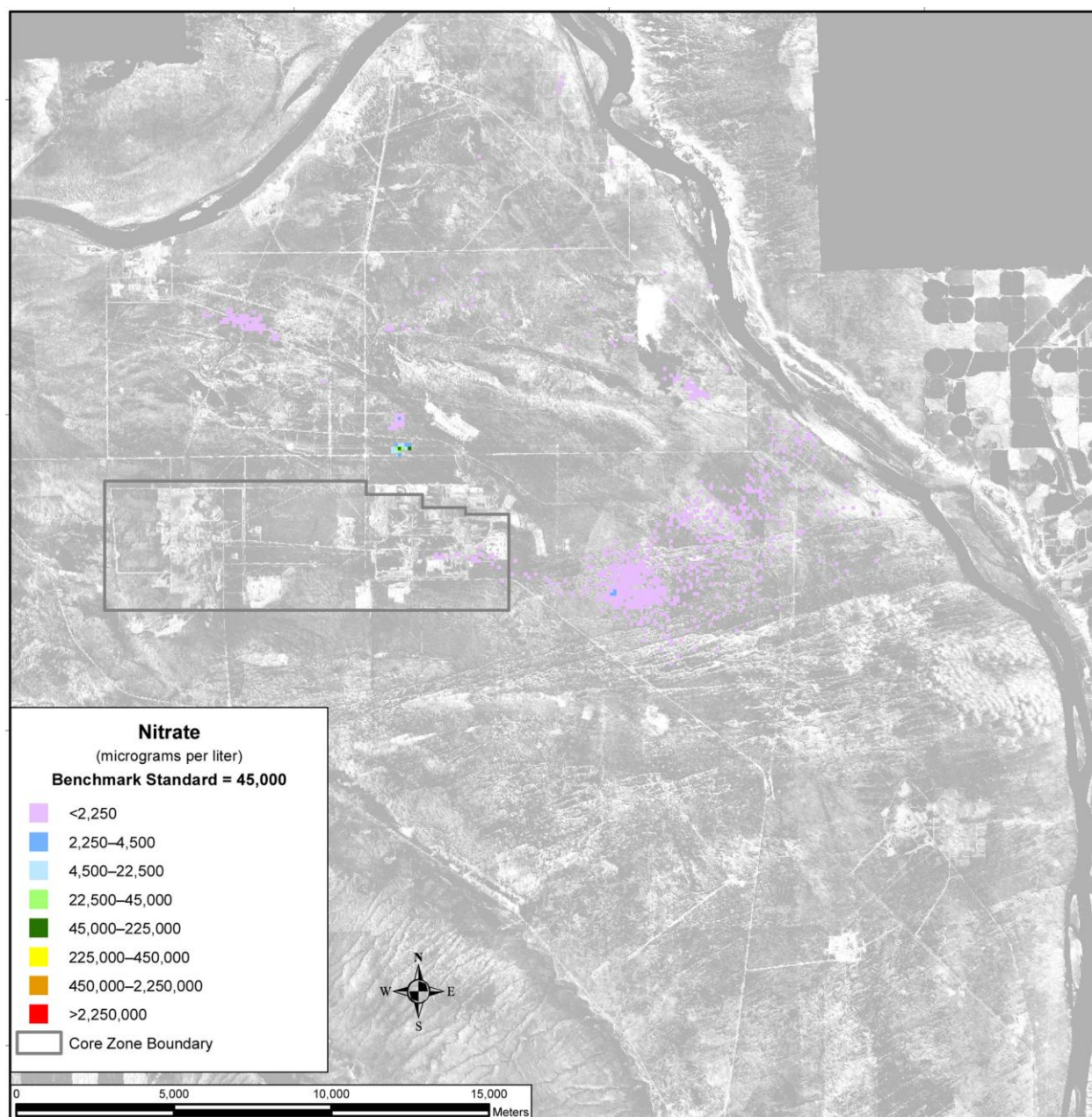


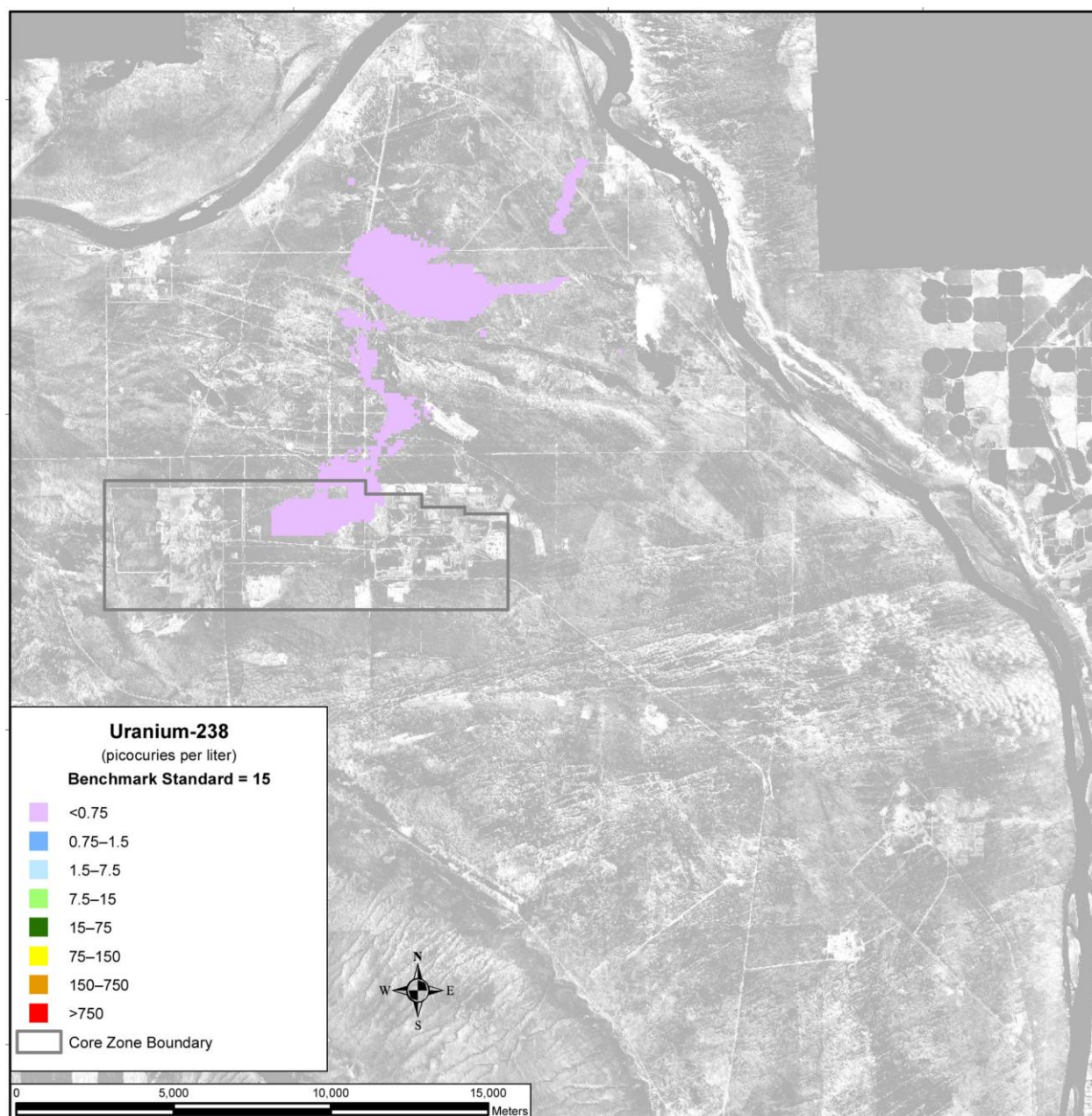
Figure 5–1123. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



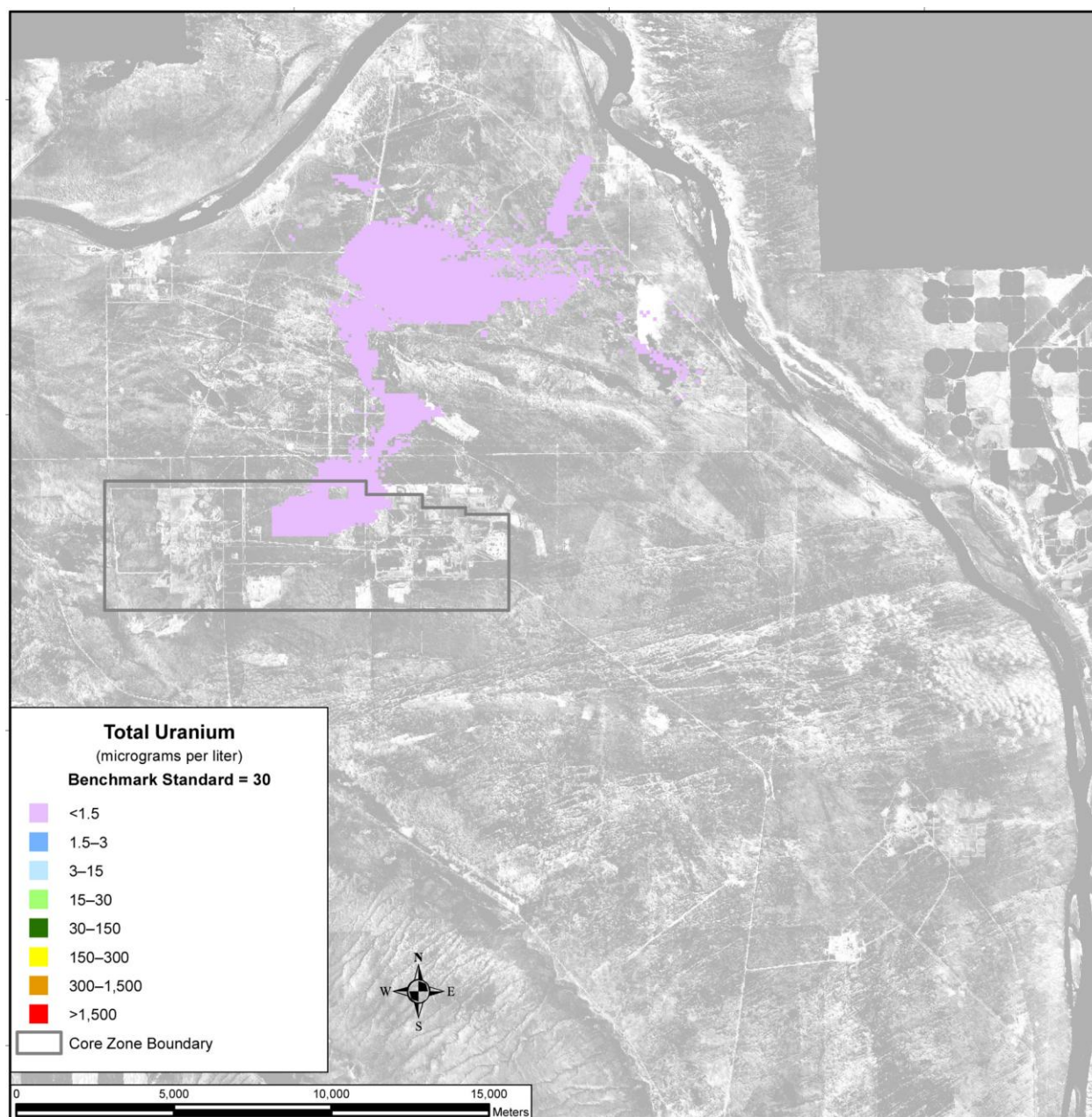
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1124. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution Year of Groundwater Nitrate Concentration, Calendar Year 11,885

Total uranium and uranium-238 show a different spatial distribution over time. They are not as mobile as the COPCs discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. By CY 11,885, there is a uranium-238 plume extending northeast from IDF-West through Gable Gap (see Figure 5–1125). A total uranium plume extends through Gable Gap from the RPPDF (see Figure 5–1126). Concentrations in all areas of the plumes remain below one-twentieth of the benchmark.



**Figure 5–1125. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial
Distribution of Groundwater Uranium-238 Concentration, Calendar Year 11,885**



Note: To convert meters to feet, multiply by 3.281.

Figure 5–1126. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 3, Option Case, in general, discharges from IDF-West are predominant contributors; those from IDF-East and the RPPDF are secondary contributors.

Concentrations of iodine-129 and technetium-99 show a sharp rise and fall between CY 2940 and CY 4940 that exceeds the benchmark by an order of magnitude or slightly more. Concentrations of these COPCs continue to decline at a slower rate after CY 4940, reaching a level around an order of magnitude below the benchmark. Chromium and nitrate show a similar rise and fall, but remain about two orders of magnitude below the benchmark.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species remain well below the benchmark at the Core Zone Boundary and the Columbia River throughout the simulation. The intensity is highest and the area of the contamination plumes largest near the end of the period of analysis.

5.3.2 Human Health Impacts

Potential human health impacts due to release of radionuclides are estimated as dose and as lifetime risk of incidence of cancer (i.e., radiological risk). For long-term performance assessment, radiological dose and risk are estimated consistent with the recommendations of *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13 (Eckerman et al. 1999), including use of radionuclide-specific dose factors and risk coefficients. Potential human health effects due to the release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of a group of chemicals. Further information on the nature of human health effects in response to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. Screening analysis identified 14 radioactive and 26 chemical constituents as contributing the greatest risk of adverse impacts. Appendix Q provides more information on the screening analysis and on results of detailed analysis, including time of occurrence of peak impacts and constituent- and location-specific impacts under each Tank Closure, FFTF Decommissioning, and Waste Management alternative.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year for 10,000 years for each receptor at seven specific locations (i.e., LLBG 218-W-5, trenches 31 and 34; IDF-East; IDF-West; the RPPDF; the Core Zone Boundary; the Columbia River nearshore; and the Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observation that peak risk and peak noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. Also, to summarize time dependence of impacts, time series of lifetime risk are presented only for locations of likely maximum impact, that is, nearfield barriers and the Core Zone Boundary.

Impacts on human health over the long time period following stabilization or closure of the waste management disposal facilities would be due primarily to naturally occurring release mechanisms and the degradation of waste forms over time. These releases would involve both radioactive and chemical constituents.

Onsite locations comprise the barriers of LLBG 218-W-5, trenches 31 and 34; IDF-East; IDF-West; the RPPDF; the Core Zone Boundary; and the Columbia River nearshore. Offsite locations comprise access points to Columbia River surface water near the site and at population centers downstream of the site. Estimates of concentrations of constituents in the Columbia River surface water are used to calculate impacts for both offsite location points of analysis. The total population of downstream water users was assumed to be 5 million people for the entire 10,000-year period of analysis (DOE 1987). Four types of receptors are considered. The first type, a drinking-water well user, uses groundwater as a source of drinking water. The second type, a resident farmer, uses either groundwater or surface water for drinking water consumption and irrigation of crops. Garden size and crop yield are adequate to produce approximately 25 percent of average requirements of crops and animal products. The third type, an American Indian resident farmer, also uses either groundwater or surface water for drinking water

consumption and irrigation of crops. Garden size and crop yield are adequate to produce the entirety of the receptor's average requirements for crops and animal products. The fourth type, an American Indian hunter-gatherer, is impacted by both groundwater and surface water because he uses surface water for drinking water consumption and consumes both wild plant materials, which use groundwater, and game, which use surface water. Members of the offsite population are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this chapter for the resident farmer at the Columbia River surface-water location.

The significance of dose impacts is evaluated by comparison with the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1, *Radiation Protection of the Public and the Environment*. The level of protection provided for the drinking water pathway is evaluated by comparison with applicable drinking water standards presented in Section 5.3.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. Estimation of Hazard Index less than unity indicates that observable effects would not occur.

5.3.2.1 Waste Management Alternative 1: No Action

Under Waste Management Alternative 1, only the wastes currently generated on site at Hanford from non-CERCLA actions would continue to be disposed of in LLBG 218-W-5, trenches 31 and 34. Although the short-term impacts do not address the impacts associated with closure activities for this site, for the purpose of analyzing long-term impacts, it was assumed that these trenches would be closed using an RCRA-compliant barrier consistent with the closure plans for these burial grounds. As a result, the non-CERLCA waste disposed of in these trenches from CY 2008 through 2035 would become available for release to the environment.

Potential human health impacts of this alternative are summarized in Tables 5-118 and 5-119. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. In addition, the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 2.23×10^{-4} person-rem per year for the year of maximum impact. This corresponds to 1.43×10^{-8} percent of the annual population dose due to background exposure. The time series of lifetime radiological risk for the drinking-water well user at the Core Zone Boundary is presented in Figure 5-1127. The estimated lifetime risks are relatively low, with a peak of approximately 4×10^{-7} , indicating low rates of release from the disposal trenches.

Table 5–118. Waste Management Alternative 1 Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
Trenches 31 and 34	1.39×10 ⁻²	1.00×10 ⁻²	4.36×10 ⁻⁷	0.00	4.36×10 ⁻⁷	3.34×10 ⁻²	1.39×10 ⁻²	1.40×10 ⁻⁶	3.71×10 ⁻¹²	1.40×10 ⁻⁶
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	9.90×10 ⁻⁴	6.87×10 ⁻⁴	3.21×10 ⁻⁸	0.00	3.21×10 ⁻⁸	2.44×10 ⁻³	9.12×10 ⁻⁴	1.04×10 ⁻⁷	2.61×10 ⁻¹³	1.04×10 ⁻⁷
Columbia River nearshore	2.42×10 ⁻³	1.66×10 ⁻³	7.67×10 ⁻⁸	0.00	7.67×10 ⁻⁸	5.86×10 ⁻³	2.24×10 ⁻³	2.47×10 ⁻⁷	6.20×10 ⁻¹³	2.47×10 ⁻⁷
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	0.00	0.00	0.00	0.00	0.00

Key: mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–119. Waste Management Alternative 1 American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
Trenches 31 and 34	6.65×10 ⁻²	2.39×10 ⁻²	3.04×10 ⁻⁶	1.70×10 ⁻⁷	3.20×10 ⁻⁶	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	4.90×10 ⁻³	1.56×10 ⁻³	2.26×10 ⁻⁷	1.19×10 ⁻⁸	2.35×10 ⁻⁷	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.17×10 ⁻²	3.83×10 ⁻³	5.37×10 ⁻⁷	2.84×10 ⁻⁸	5.63×10 ⁻⁷	3.94×10 ⁻⁵	8.21×10 ⁻⁴	2.03×10 ⁻⁹	2.84×10 ⁻⁸	3.03×10 ⁻⁸
Off Site										
Columbia River	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	N/A	N/A

Key: mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

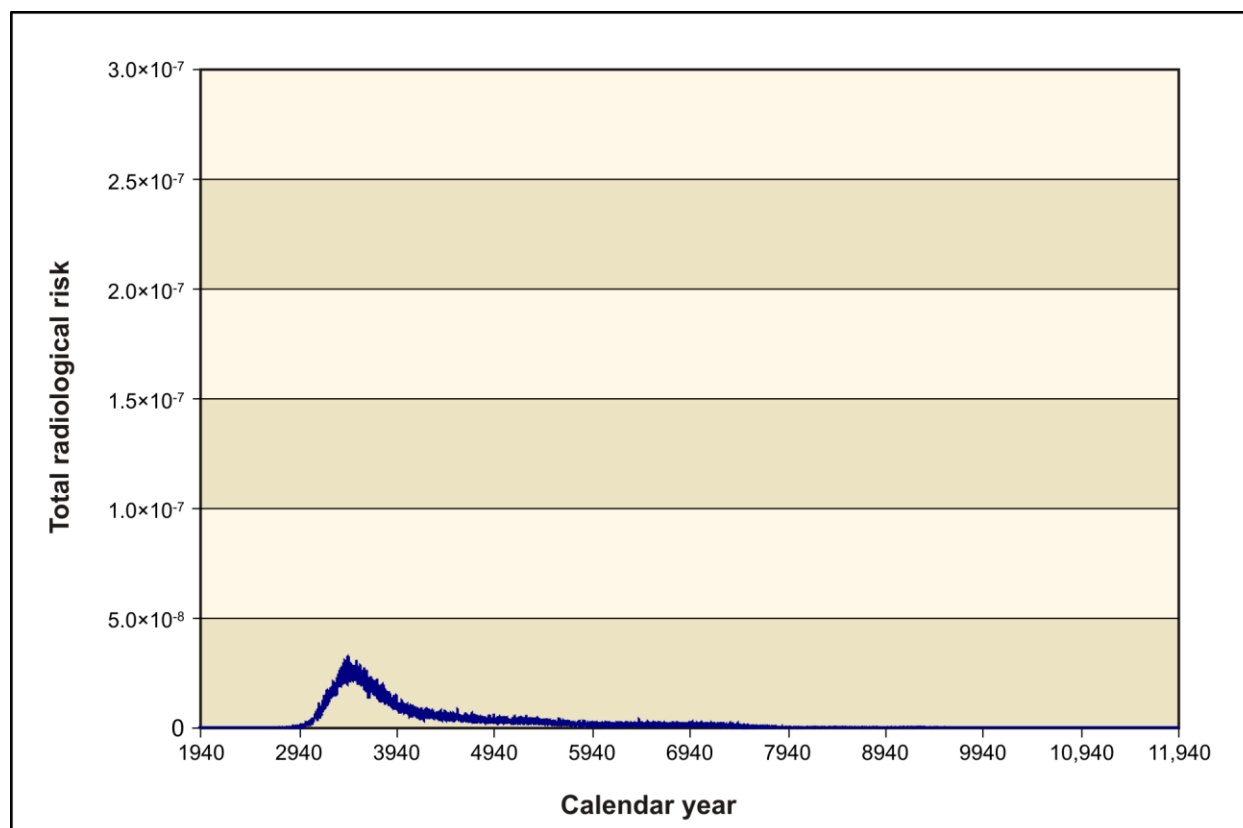


Figure 5-1127. Waste Management Alternative 1 Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only

Under Waste Management Alternative 2, waste from tank treatment operations, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-East. Waste from tank farm cleanup activities would be disposed of in the RPPDF. As a result, the waste disposed of in these two facilities would become available for release to the environment. Because different waste types would result from the Tank Closure action alternatives, three disposal groups were considered to account for the different sizes and operational time periods of IDF-East. In addition, within these three disposal groups, subgroups were identified to allow consideration of the different waste types resulting from the Tank Closure alternatives. Potential human health impacts of these subgroups under this alternative are discussed in the following sections.

5.3.2.2.1 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-A

Disposal Group 1, Subgroup 1-A, addresses the waste resulting from Tank Closure Alternative 2B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-120 and 5-121. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 1.68×10^{-1} person-rem per year for the year of maximum impact. This

corresponds to 1.08×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and at the Core Zone Boundary are presented in Figures 5–1128 and 5–1129, respectively. Review of the source term inventories (see Appendix D), cumulative release to the unconfined aquifer (see Appendix N), sensitivity analysis (see Appendix N), and estimates of impact presented later in this section support the interpretation that the majority of the radiological impact in the year of peak dose at both the IDF-East barrier (see Figure 5–1128) and Core Zone Boundary (see Figure 5–1129) is due to release of technetium-99 and iodine-129 from offsite waste. For chemical constituents, greater than 90 percent of the noncarcinogenic impact during the year of peak impact is due to release of nitrate from ETF-generated secondary waste. Releases from ILAW glass provide a minor contribution to estimated impacts. The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1129) shows a small peak in CY 3700 due to releases from the RPPDF, while the larger peak in CY 8000 is due to releases from IDF-East.

Table 5–120. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

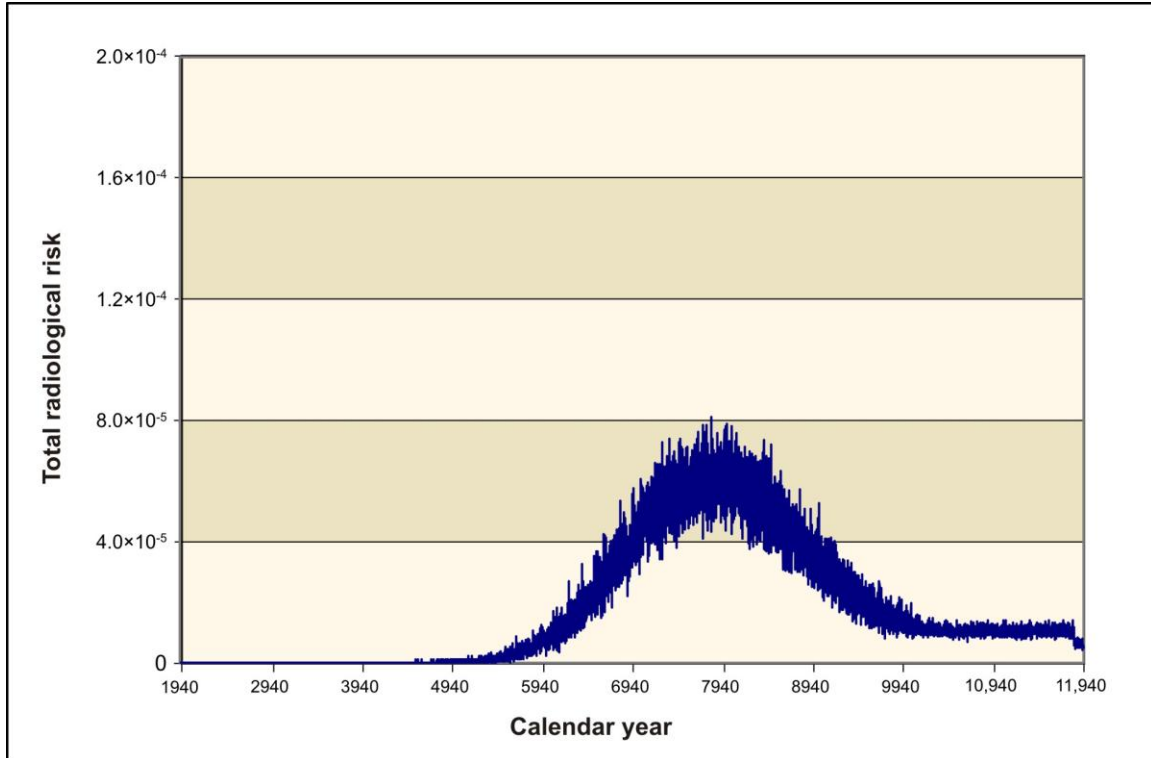
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.70	2.29×10^{-1}	8.14×10^{-5}	0.00	8.14×10^{-5}	6.30	1.71	2.58×10^{-4}	8.22×10^{-12}	2.58×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.01	5.76×10^{-2}	3.14×10^{-5}	0.00	3.14×10^{-5}	2.41	4.27×10^{-1}	1.01×10^{-4}	2.94×10^{-12}	1.01×10^{-4}
Columbia River nearshore	7.56×10^{-1}	3.80×10^{-2}	2.38×10^{-5}	0.00	2.38×10^{-5}	1.82	2.87×10^{-1}	7.63×10^{-5}	1.67×10^{-12}	7.63×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.35×10^{-5}	5.67×10^{-6}	1.36×10^{-9}	0.00	1.36×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

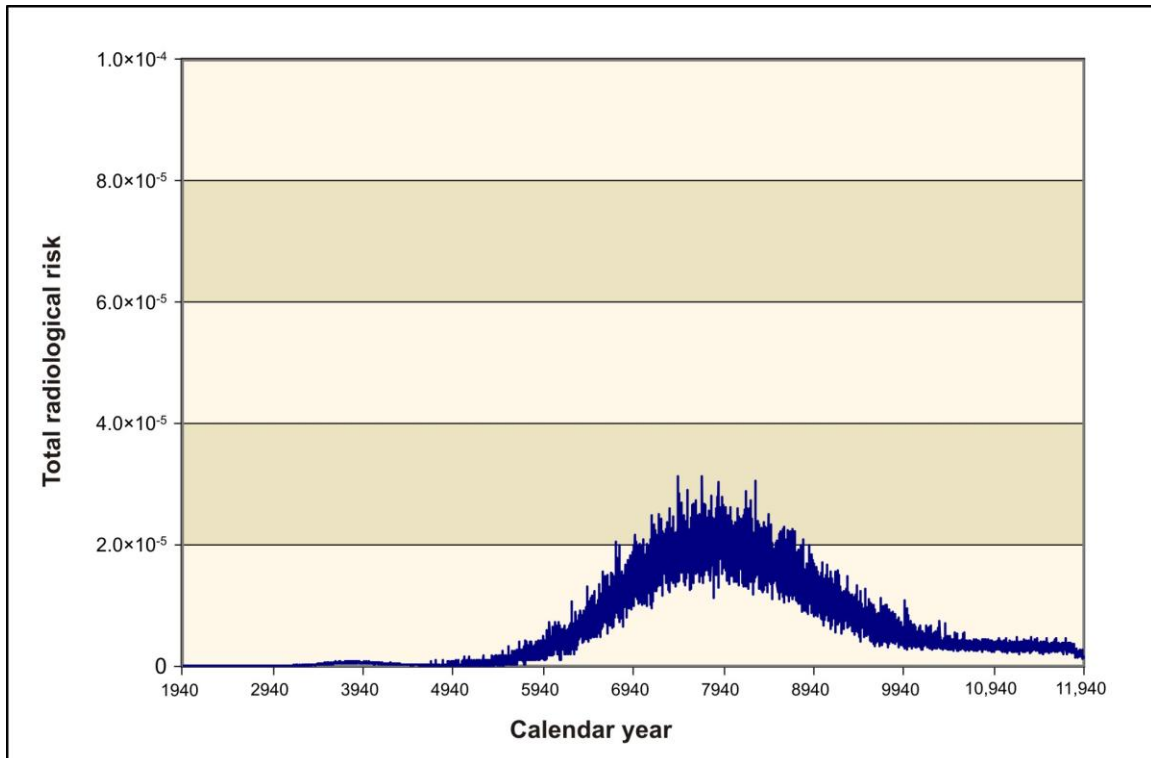
Table 5–121. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.24×10^1	3.81	5.58×10^{-4}	3.77×10^{-7}	5.59×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	4.79	9.49×10^{-1}	2.19×10^{-4}	1.35×10^{-7}	2.19×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.63	6.39×10^{-1}	1.66×10^{-4}	7.64×10^{-8}	1.66×10^{-4}	1.28×10^{-2}	1.01×10^{-1}	6.43×10^{-7}	7.64×10^{-8}	6.82×10^{-7}
Off Site										
Columbia River	1.25×10^{-4}	3.53×10^{-3}	4.61×10^{-9}	0.00	4.61×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not available; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5-1128. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**



**Figure 5-1129. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A,
Time Series of Radiological Risk for the Drinking-Water Well User
at the Core Zone Boundary**

5.3.2.2.2 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-B

Disposal Group 1, Subgroup 1-B, addresses the waste resulting from Tank Closure Alternative 3A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–122 and 5–123. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 2.78×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.79×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1130 and 5–1131, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (9.7×10^{-5}) is due to release of radioactive constituents from offsite LLW. At both the IDF-East barrier and the Core Zone Boundary, approximately 85 and 15 percent of the dose in the year of peak dose is due to technetium-99 and iodine-129, respectively. In each case, the source of the constituent is offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, nearly the entirety of noncarcinogenic impact is due to release of nitrate from ETF-generated secondary waste.

The major contributor to risk for the bulk vitrification glass is release of technetium-99 from the castable refractory block portion of the waste form package. The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1131) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–122. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.06	1.89×10^{-1}	9.68×10^{-5}	0.00	9.68×10^{-5}	7.39	1.45	3.11×10^{-4}	3.72×10^{-12}	3.11×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.43	5.16×10^{-2}	4.64×10^{-5}	0.00	4.64×10^{-5}	3.53	3.94×10^{-1}	1.50×10^{-4}	2.94×10^{-12}	1.50×10^{-4}
Columbia River nearshore	1.17	4.05×10^{-2}	3.78×10^{-5}	0.00	3.78×10^{-5}	2.87	3.11×10^{-1}	1.22×10^{-4}	1.11×10^{-12}	1.22×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	5.55×10^{-5}	5.11×10^{-6}	2.34×10^{-9}	0.00	2.34×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–123. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.48×10^1	3.22	6.77×10^{-4}	1.71×10^{-7}	6.77×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	7.09	8.78×10^{-1}	3.27×10^{-4}	1.35×10^{-7}	3.27×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	5.77	6.92×10^{-1}	2.66×10^{-4}	5.07×10^{-8}	2.66×10^{-4}	1.99×10^{-2}	1.01×10^{-1}	1.02×10^{-6}	5.07×10^{-8}	1.04×10^{-6}
Off Site										
Columbia River	1.75×10^{-4}	3.18×10^{-3}	6.96×10^{-9}	0.00	6.96×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

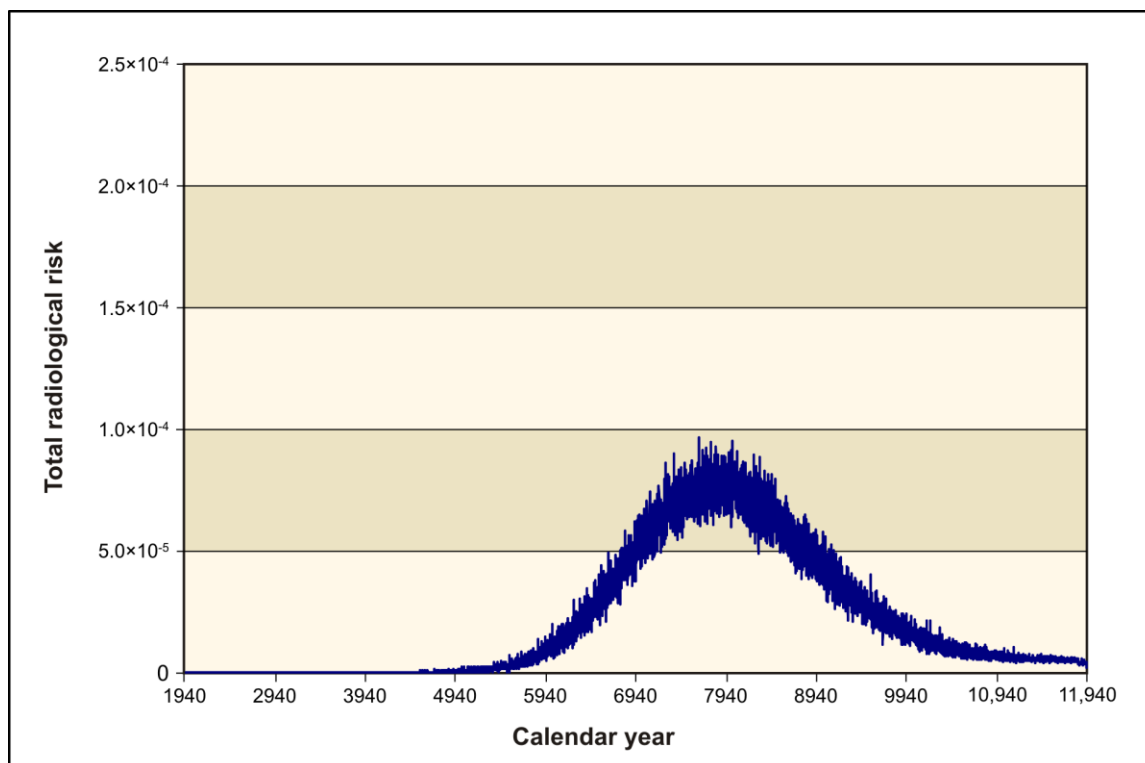


Figure 5-1130. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

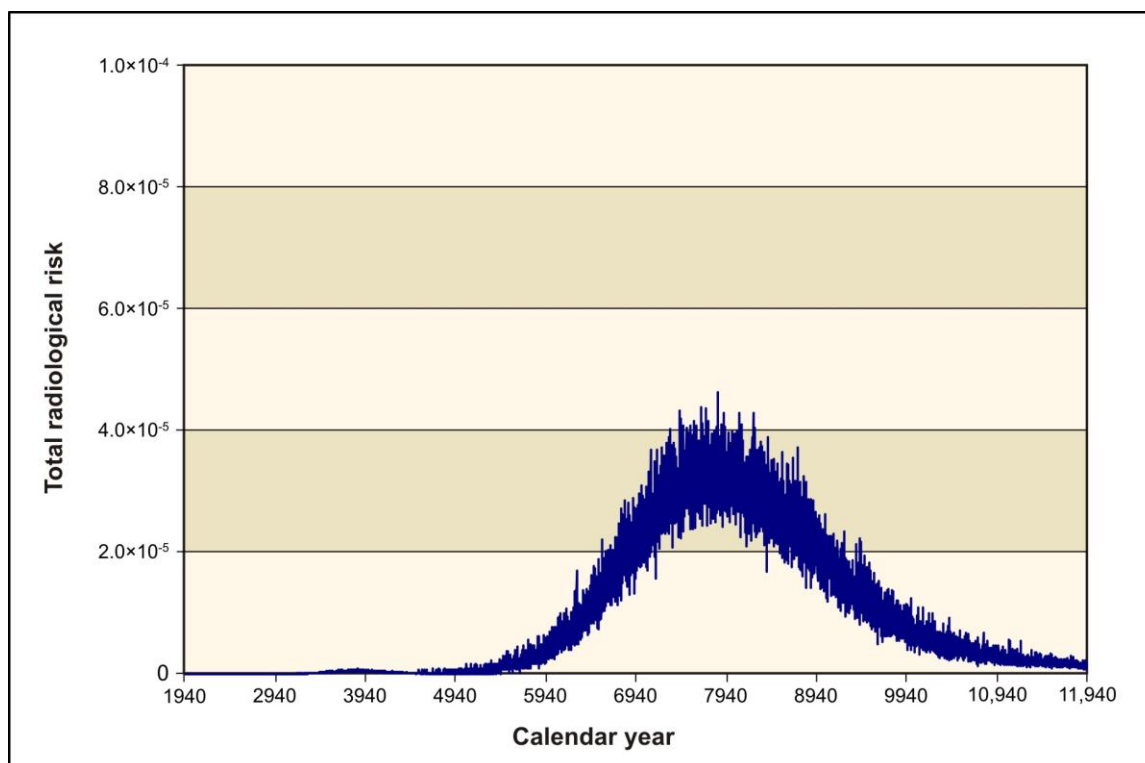


Figure 5-1131. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.3 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-C

Disposal Group 1, Subgroup 1-C, addresses the waste resulting from Tank Closure Alternative 3B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–124 and 5–125. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. However, the Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier, Core Zone Boundary, and Columbia River nearshore for the resident farmer and American Indian resident farmer and at the IDF-East barrier and Core Zone Boundary for the drinking-water well user. Population dose is estimated as 3.28×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.11×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1132 and 5–1133, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.8×10^{-4}) is due to release of radioactive constituents from cast stone waste. At both the IDF-East barrier and the Core Zone Boundary, greater than 95 percent of the dose in the year of peak dose is due to technetium-99 from the cast stone waste. Secondary contribution to dose is due to release of iodine-129 from the ETF-generated secondary waste and offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (85 percent of Hazard Index) and nitrate (15 percent of Hazard Index) from the cast stone waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1133) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–124. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

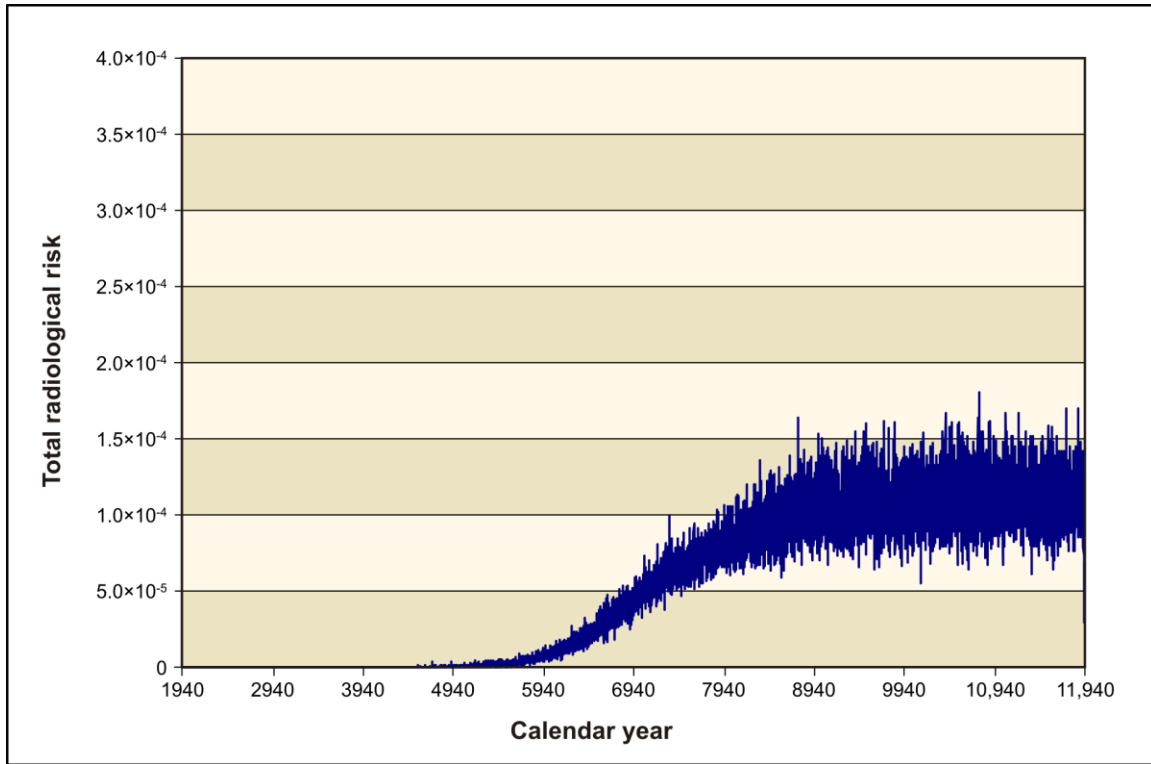
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.31	3.40	1.81×10^{-4}	0.00	1.81×10^{-4}	1.36×10^1	8.39	5.94×10^{-4}	1.16×10^{-9}	5.94×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.94	1.11	6.44×10^{-5}	0.00	6.44×10^{-5}	4.86	3.03	2.10×10^{-4}	3.99×10^{-10}	2.10×10^{-4}
Columbia River nearshore	1.60	8.56×10^{-1}	5.46×10^{-5}	0.00	5.46×10^{-5}	4.09	2.17	1.79×10^{-4}	3.08×10^{-10}	1.79×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.57×10^{-5}	3.95×10^{-5}	2.82×10^{-9}	4.59×10^{-15}	2.82×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

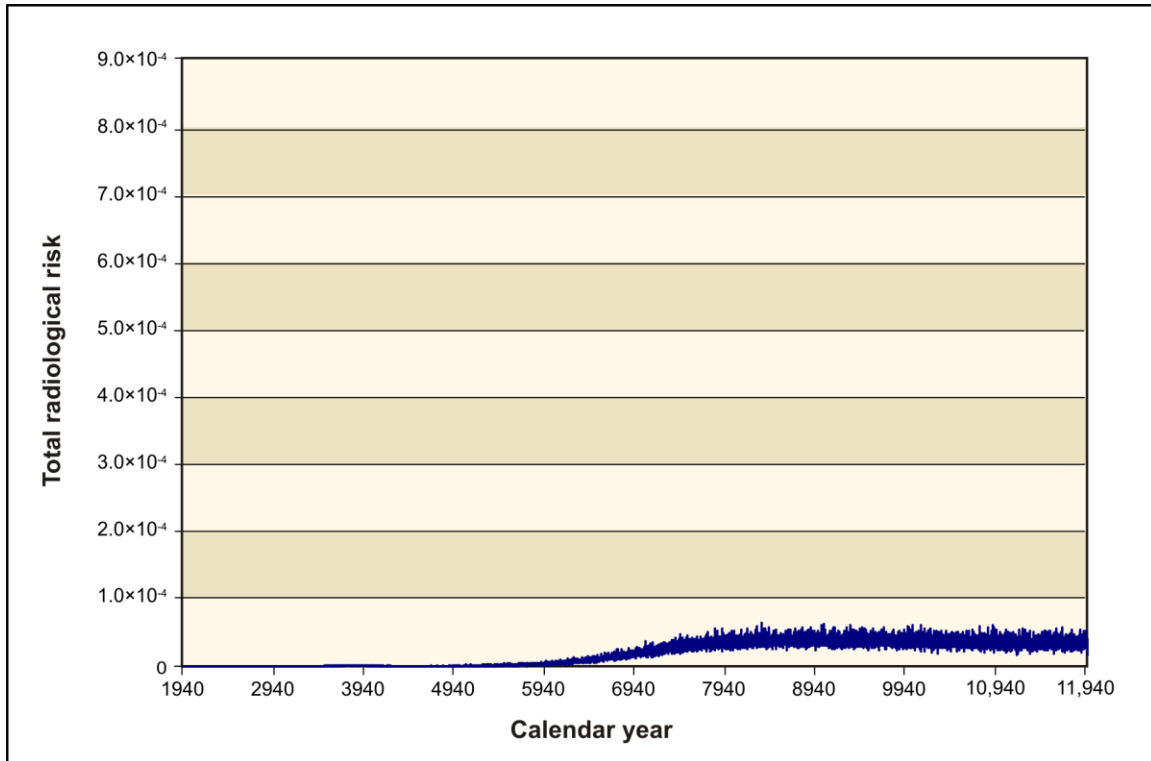
Table 5–125. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.77×10^1	1.70×10^1	1.30×10^{-3}	5.32×10^{-5}	1.31×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	9.84	6.20	4.58×10^{-4}	1.83×10^{-5}	4.67×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	8.35	4.37	3.92×10^{-4}	1.41×10^{-5}	3.95×10^{-4}	2.75×10^{-2}	8.18×10^{-1}	1.46×10^{-6}	1.41×10^{-5}	1.49×10^{-5}
Off Site										
Columbia River	1.89×10^{-4}	1.80×10^{-2}	7.90×10^{-9}	2.11×10^{-10}	8.07×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5-1132. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**



**Figure 5-1133. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C,
Time Series of Radiological Risk for the Drinking-Water Well User
at the Core Zone Boundary**

5.3.2.2.4 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-D

Disposal Group 1, Subgroup 1-D, addresses the waste resulting from Tank Closure Alternative 3C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–126 and 5–127. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to nitrate at the IDF-East barrier for the resident farmer and American Indian resident farmer. The Hazard Index guideline would also be exceeded at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 2.11×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.36×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1134 and 5–1135, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.7×10^{-5}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (90 percent of peak dose) and iodine-129 (10 percent of peak dose). In each case, the source of the constituent is offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from steam reforming waste (33 percent of Hazard Index) and nitrate from ETF-generated secondary waste (67 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from steam reforming waste (44 percent of Hazard Index) and nitrate from ETF-generated secondary waste (56 percent of Hazard Index).

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1135) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–126. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.88	3.05×10^{-1}	8.72×10^{-5}	0.00	8.72×10^{-5}	6.74	1.71	2.81×10^{-4}	7.57×10^{-11}	2.81×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.18	9.26×10^{-2}	3.80×10^{-5}	0.00	3.80×10^{-5}	2.90	4.66×10^{-1}	1.23×10^{-4}	2.38×10^{-11}	1.23×10^{-4}
Columbia River nearshore	9.66×10^{-1}	6.38×10^{-2}	3.04×10^{-5}	0.00	3.04×10^{-5}	2.31	3.57×10^{-1}	9.80×10^{-5}	1.83×10^{-11}	9.80×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	4.22×10^{-5}	6.27×10^{-6}	1.74×10^{-9}	2.90×10^{-16}	1.74×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–127. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.33×10^1	3.74	6.11×10^{-4}	3.47×10^{-6}	6.12×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.81	1.02	2.67×10^{-4}	1.09×10^{-6}	2.68×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	4.63	7.82×10^{-1}	2.13×10^{-4}	8.39×10^{-7}	2.13×10^{-4}	1.62×10^{-2}	1.20×10^{-1}	8.19×10^{-7}	8.38×10^{-7}	1.26×10^{-6}
Off Site										
Columbia River	1.49×10^{-4}	3.68×10^{-3}	5.63×10^{-9}	1.33×10^{-11}	5.63×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not available; Nonrad.=nonradiological; Rad.=radiological; yr=year.

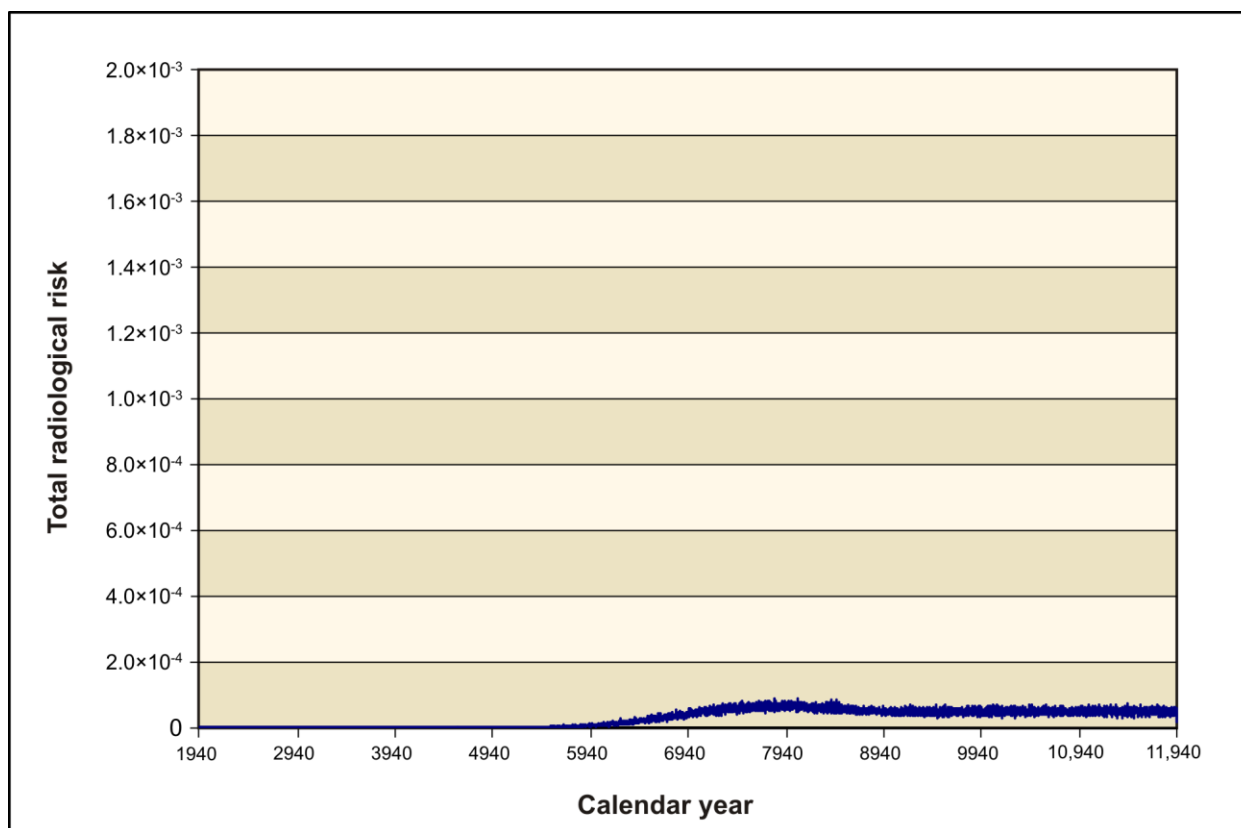
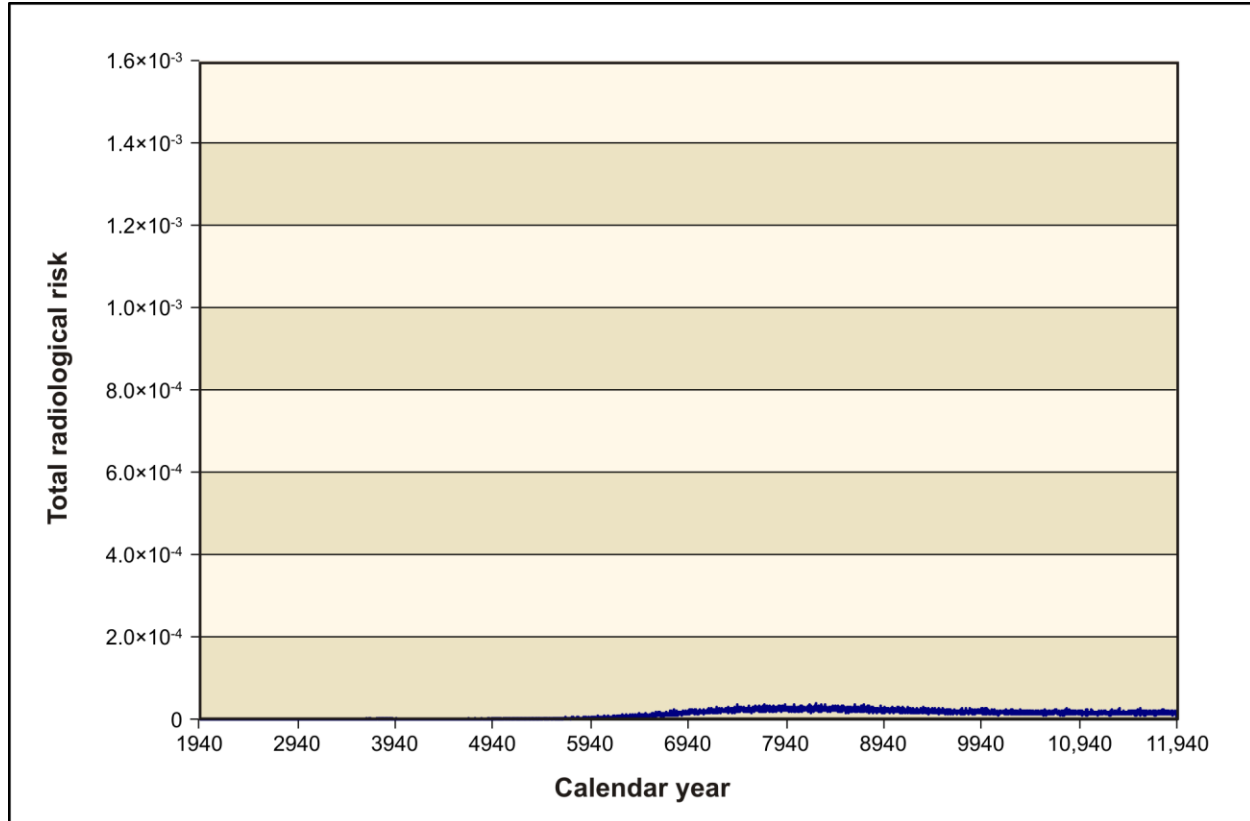


Figure 5–1134. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier



**Figure 5-1135. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D,
Time Series of Radiological Risk for the Drinking-Water Well User
at the Core Zone Boundary**

5.3.2.2.5 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-E

Disposal Group 1, Subgroup 1-E, addresses the waste resulting from Tank Closure Alternative 4, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-128 and 5-129. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer. The Hazard Index guideline would also be exceeded due primarily to chromium and nitrate at the Core Zone Boundary and Columbia River nearshore locations for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.99×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.57×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1136 and 5-1137, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (2.3×10^{-3}) is due to release of radioactive constituents from cast stone waste. At both the IDF-East barrier and the Core Zone Boundary, greater than 97 percent of the dose in the year of peak dose is due to technetium-99. In each case, the source of the constituent is cast stone waste. For chemical constituents, greater than

80 percent of Hazard Index reported at the IDF-East barrier is due to chromium, while at the Core Zone Boundary, greater than 90 percent of Hazard Index is due to nitrate. In each case, the source is cast stone waste.

The major contributor to risk for the low-activity waste sources is release of technetium-99 from cast stone waste and the castable refractory block portion of the bulk vitrification glass waste form package. The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1137) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–128. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	6.89	2.08	2.34×10^{-4}	0.00	2.34×10^{-4}	1.76×10^1	5.14	7.67×10^{-4}	6.88×10^{-10}	7.67×10^{-4}
River Protection Project Disposal Facility	2.37×10^{-1}	6.92×10^{-2}	7.01×10^{-6}	0.00	7.01×10^{-6}	5.45×10^{-1}	1.01×10^{-1}	2.21×10^{-5}	2.69×10^{-11}	2.21×10^{-5}
Core Zone Boundary	2.49	6.26×10^{-1}	8.45×10^{-5}	0.00	8.45×10^{-5}	6.35	1.63	2.77×10^{-4}	2.06×10^{-10}	2.77×10^{-4}
Columbia River nearshore	2.07	4.68×10^{-1}	7.07×10^{-5}	0.00	7.07×10^{-5}	5.31	1.16	2.32×10^{-4}	1.56×10^{-10}	2.32×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.98×10^{-5}	2.32×10^{-5}	3.43×10^{-9}	2.59×10^{-15}	3.43×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–129. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.58×10^1	1.04×10^1	1.67×10^{-3}	3.16×10^{-5}	1.68×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.07	1.78×10^{-1}	4.77×10^{-5}	1.23×10^{-6}	4.86×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.29×10^1	3.32	6.05×10^{-4}	9.46×10^{-6}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.08×10^1	2.44	5.07×10^{-4}	7.17×10^{-6}	5.08×10^{-4}	3.55×10^{-2}	4.29×10^{-1}	1.89×10^{-6}	7.17×10^{-6}	7.99×10^{-6}
Off Site										
Columbia River	2.28×10^{-4}	1.09×10^{-2}	9.61×10^{-9}	1.19×10^{-10}	9.71×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not available; Nonrad.=nonradiological; Rad.=radiological; yr=year.

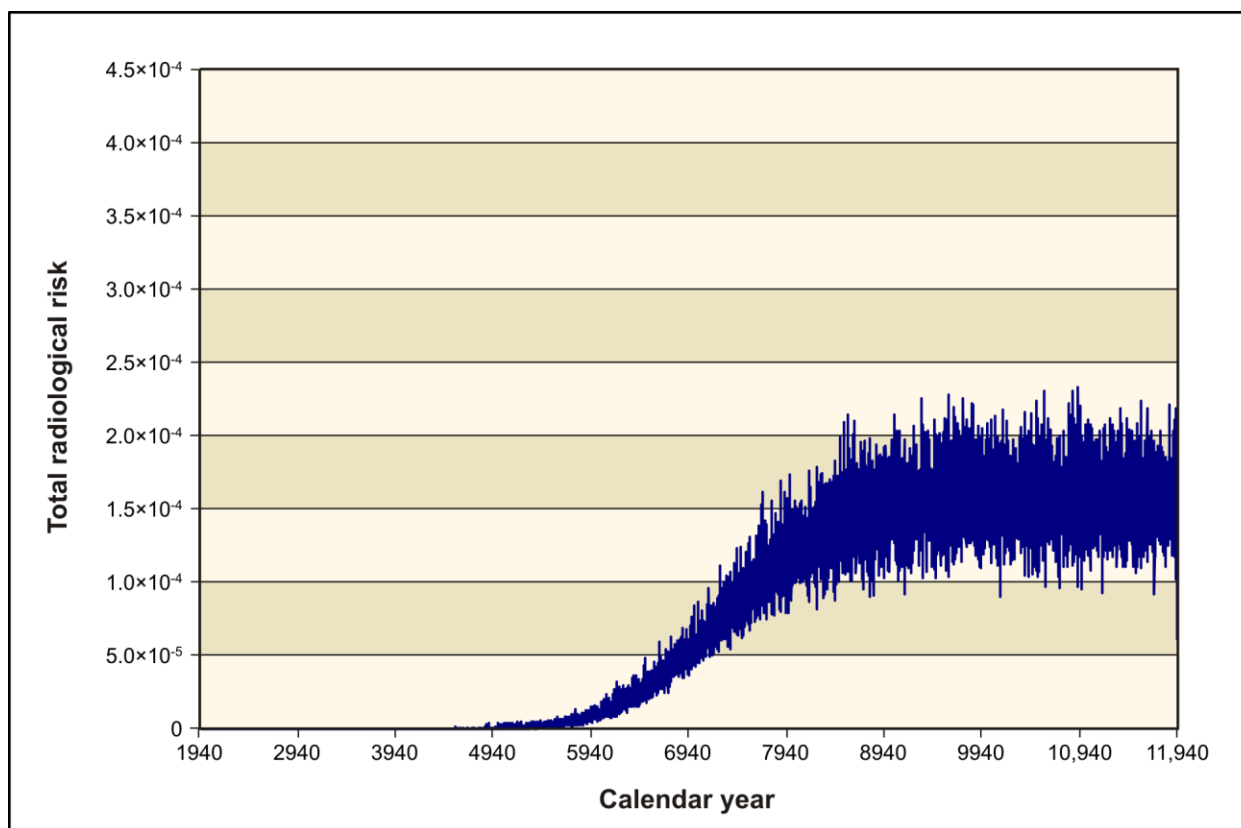


Figure 5–1136. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

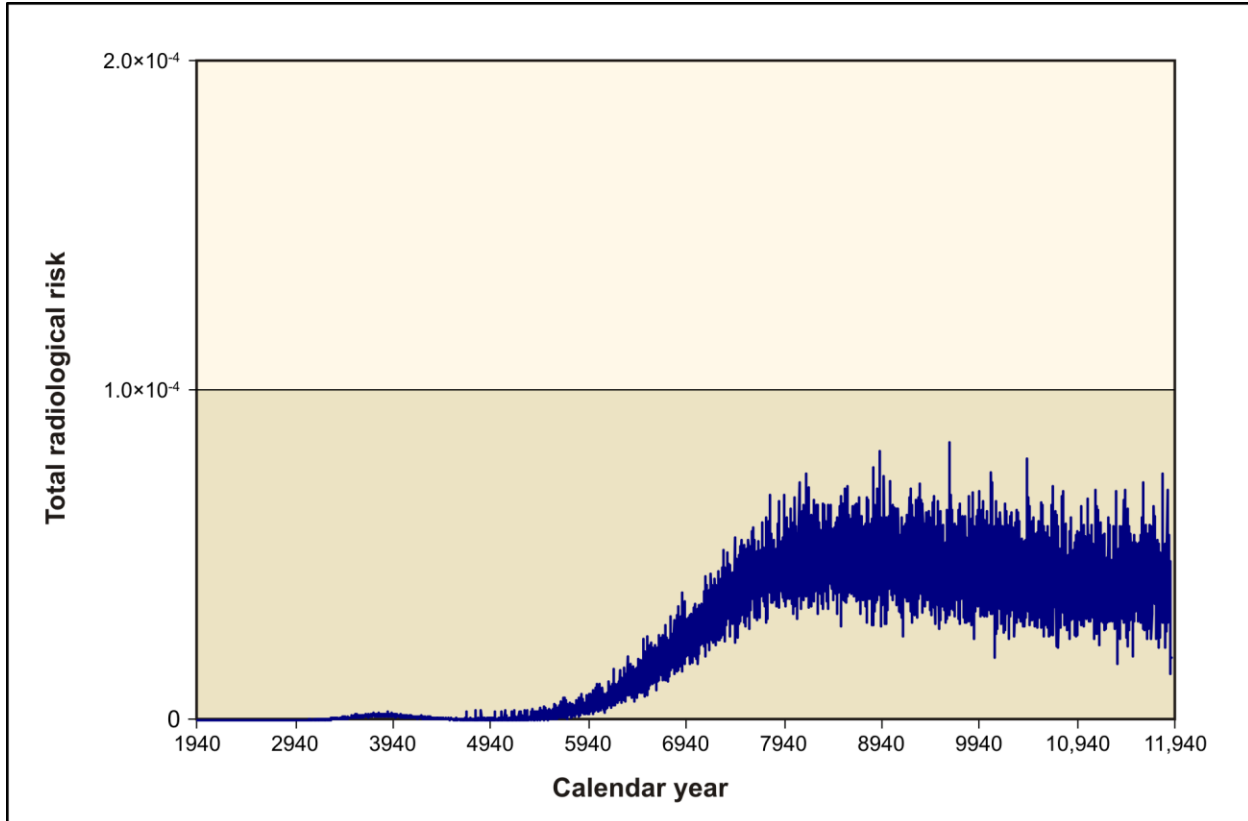


Figure 5-1137. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.6 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-F

Disposal Group 1, Subgroup 1-F, addresses the waste resulting from Tank Closure Alternative 5, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-130 and 5-131. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer. The Hazard Index guideline would also be exceeded at the Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated as 2.59×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.66×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1138 and 5-1139, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (9.2×10^{-5}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier and the Core Zone Boundary, approximately 83 and 90 percent of the dose in the year of peak dose is due to technetium-99, respectively. In each case, the source of the constituent is offsite LLW. For chemical constituents, at both the IDF-East barrier and the Core Zone Boundary, greater than 90 percent of noncarcinogenic impact

is due to release of chromium from sulfate grout. The balance of the noncarcinogenic chemical impact is due to release of nitrate from ETF-generated secondary waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1139) does not include an early peak, as the RPPDF is not constructed for this alternative, but does include a late peak due to sources at IDF-East.

Table 5–130. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.01	3.03	9.20×10^{-5}	0.00	9.20×10^{-5}	7.09	4.98	2.93×10^{-4}	1.16×10^{-9}	2.93×10^{-4}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.34	8.21×10^{-1}	4.33×10^{-5}	0.00	4.33×10^{-5}	3.30	1.45	1.40×10^{-4}	3.06×10^{-10}	1.40×10^{-4}
Columbia River nearshore	1.07	6.12×10^{-1}	3.47×10^{-5}	0.00	3.47×10^{-5}	2.64	9.76×10^{-1}	1.12×10^{-4}	2.34×10^{-10}	1.12×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	5.18×10^{-5}	2.07×10^{-5}	2.16×10^{-9}	4.03×10^{-15}	2.16×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–131. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.40×10^{-1}	9.31	6.37×10^{-4}	5.31×10^{-5}	6.69×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	6.61	2.82	3.05×10^{-4}	1.40×10^{-5}	3.14×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	5.30	1.80	2.44×10^{-4}	1.07×10^{-5}	2.48×10^{-4}	1.83×10^{-2}	4.17×10^{-1}	9.35×10^{-7}	1.07×10^{-5}	1.15×10^{-5}
Off Site										
Columbia River	1.67×10^{-4}	7.46×10^{-3}	6.61×10^{-9}	1.85×10^{-10}	6.74×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

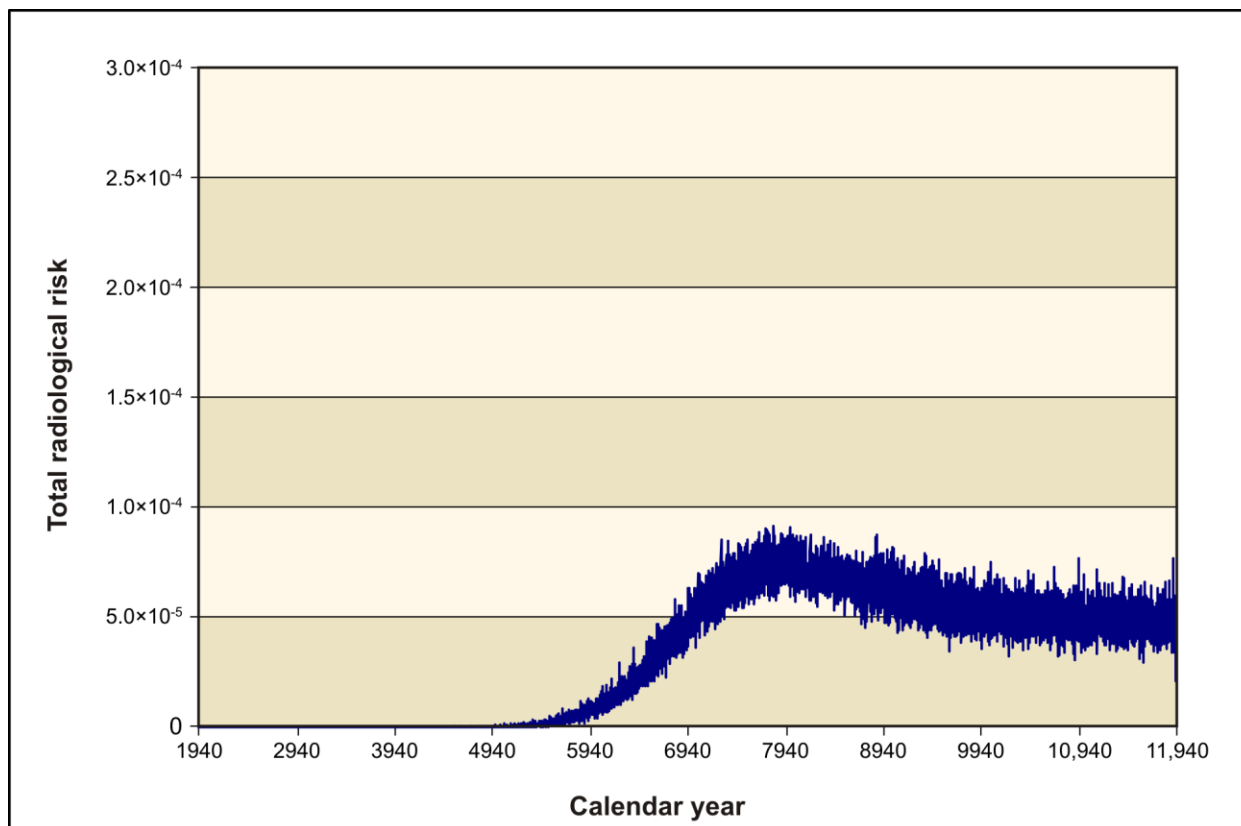


Figure 5–1138. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

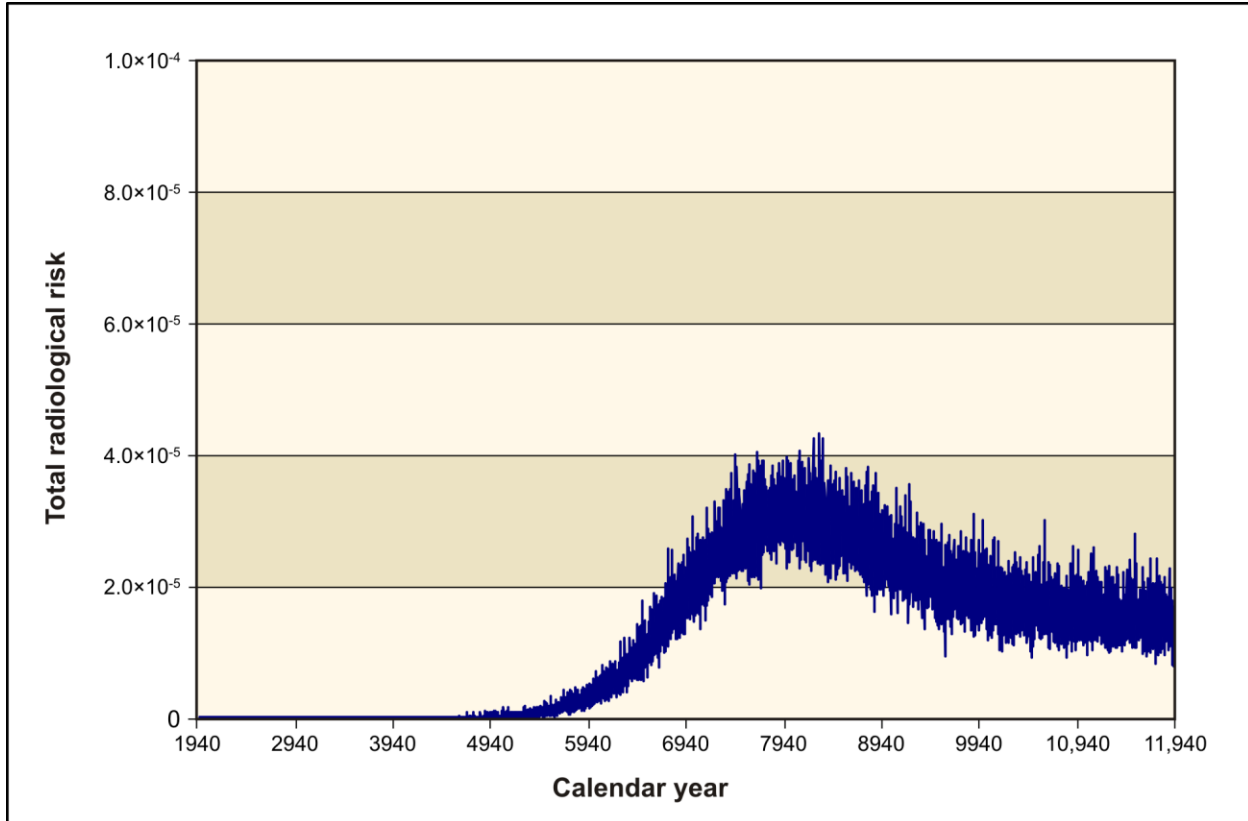


Figure 5–1139. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.7 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 1, Subgroup 1-G

Disposal Group 1, Subgroup 1-G, addresses the waste resulting from Tank Closure Alternative 6C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–132 and 5–133. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 1.67×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.07×10^{-5} percent of the annual population dose due to background exposure. The time series of lifetime radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1140 and 5–1141, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.1×10^{-5}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier and the Core Zone Boundary, greater than 85 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, greater than 95 percent of noncarcinogenic impact is due to release of nitrate from ETF-generated secondary waste.

Table 5–132. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

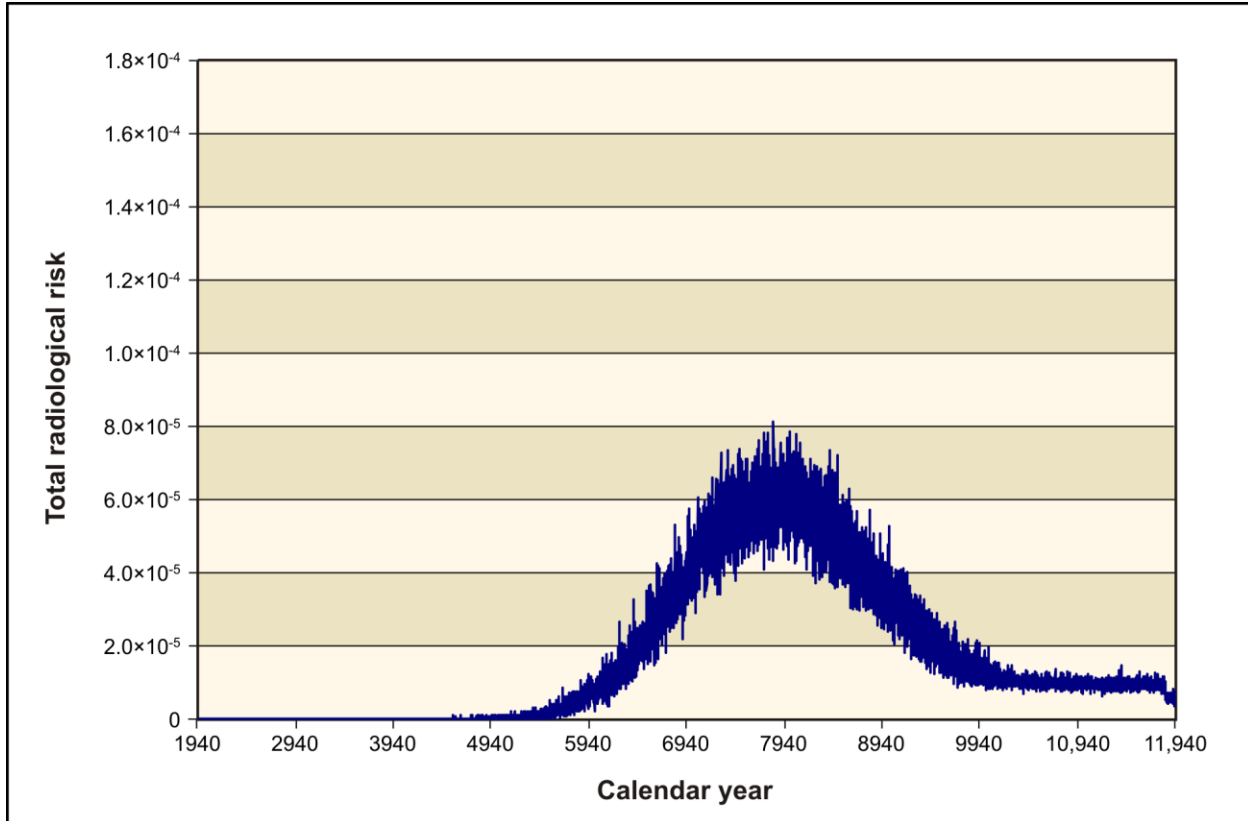
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.70	2.29×10^{-1}	8.14×10^{-5}	0.00	8.14×10^{-5}	6.30	1.71	2.58×10^{-4}	8.05×10^{-12}	2.58×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.01	5.78×10^{-2}	3.14×10^{-5}	0.00	3.14×10^{-5}	2.41	4.27×10^{-1}	1.01×10^{-4}	2.94×10^{-12}	1.01×10^{-4}
Columbia River nearshore	7.46×10^{-1}	3.81×10^{-2}	2.38×10^{-5}	0.00	2.38×10^{-5}	1.81	2.87×10^{-1}	7.65×10^{-5}	1.63×10^{-12}	7.65×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.34×10^{-5}	5.67×10^{-6}	1.36×10^{-9}	0.00	1.36×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–133. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.24×10^1	3.81	5.58×10^{-4}	3.69×10^{-7}	5.59×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	4.79	9.49×10^{-1}	2.19×10^{-4}	1.35×10^{-7}	2.19×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.63	6.39×10^{-1}	1.66×10^{-4}	7.46×10^{-8}	1.66×10^{-4}	1.27×10^{-2}	1.01×10^{-1}	6.43×10^{-7}	7.46×10^{-8}	6.98×10^{-7}
Off Site										
Columbia River	1.25×10^{-4}	3.53×10^{-3}	4.60×10^{-9}	0.00	4.60×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1140. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1141) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

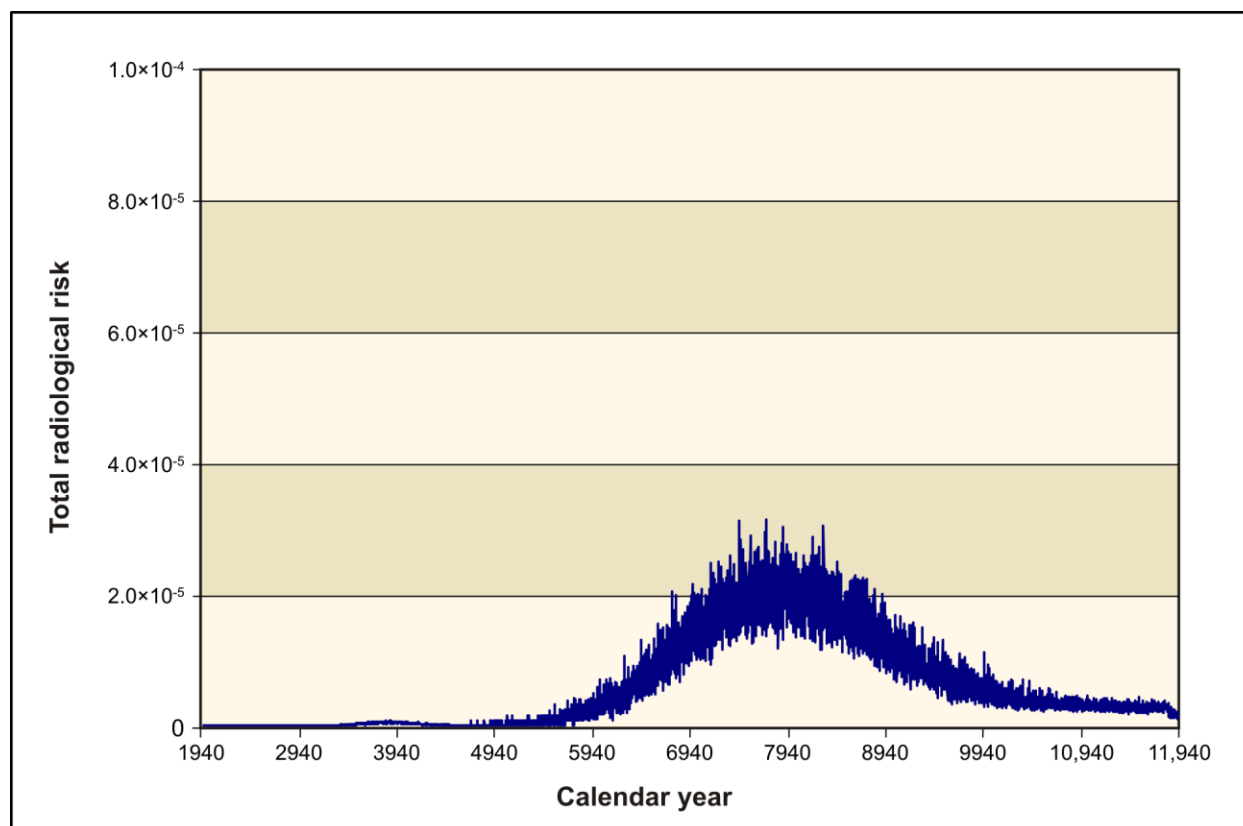


Figure 5–1141. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.8 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 2, Subgroup 2-A

Disposal Group 2, Subgroup 2-A, addresses the waste resulting from Tank Closure Alternative 2A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–134 and 5–135. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 1.67×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.08×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and at the Core Zone Boundary are presented in Figures 5–1142 and 5–1143, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.5×10^{-4}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier and the Core Zone Boundary, approximately 75 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, nearly the entirety of noncarcinogenic impact is due to release of nitrate from ETF-generated secondary waste.

Table 5–134. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.08	1.77×10^{-1}	1.50×10^{-4}	0.00	1.50×10^{-4}	1.17×10^1	1.32	4.72×10^{-4}	7.23×10^{-12}	4.72×10^{-4}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.16	5.65×10^{-2}	3.56×10^{-5}	0.00	3.56×10^{-5}	2.74	4.14×10^{-1}	1.13×10^{-4}	2.92×10^{-12}	1.13×10^{-4}
Columbia River nearshore	7.43×10^{-1}	3.58×10^{-2}	2.35×10^{-5}	0.00	2.35×10^{-5}	1.79	2.64×10^{-1}	7.54×10^{-5}	1.77×10^{-12}	7.54×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.35×10^{-5}	5.37×10^{-6}	1.36×10^{-9}	0.00	1.36×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–135. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.28×10^1	2.93	1.02×10^{-3}	3.32×10^{-7}	1.02×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.43	9.21×10^{-1}	2.46×10^{-4}	1.34×10^{-7}	2.46×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.58	5.88×10^{-1}	1.64×10^{-4}	8.11×10^{-8}	1.64×10^{-4}	1.26×10^{-2}	9.14×10^{-2}	6.34×10^{-7}	8.10×10^{-8}	6.69×10^{-7}
Off Site										
Columbia River	1.23×10^{-4}	3.34×10^{-3}	4.58×10^{-9}	0.00	4.58×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

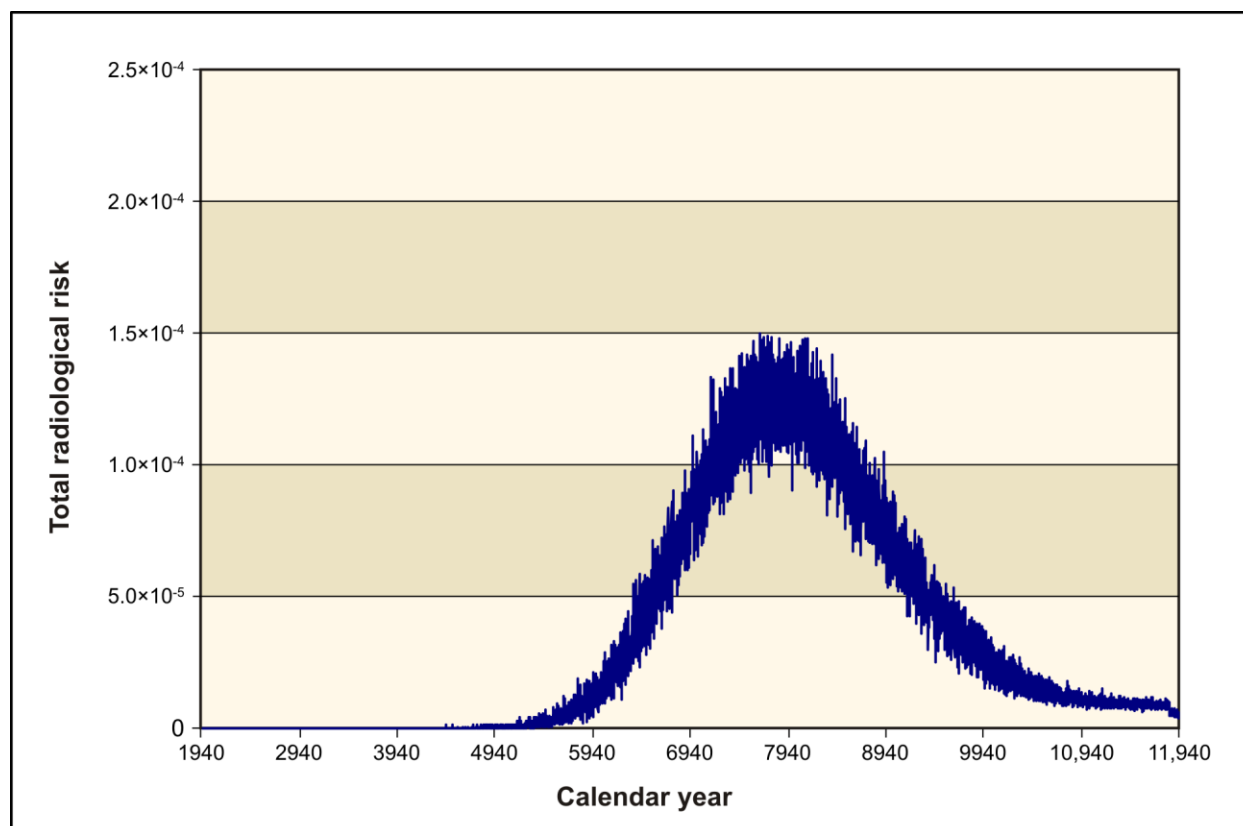
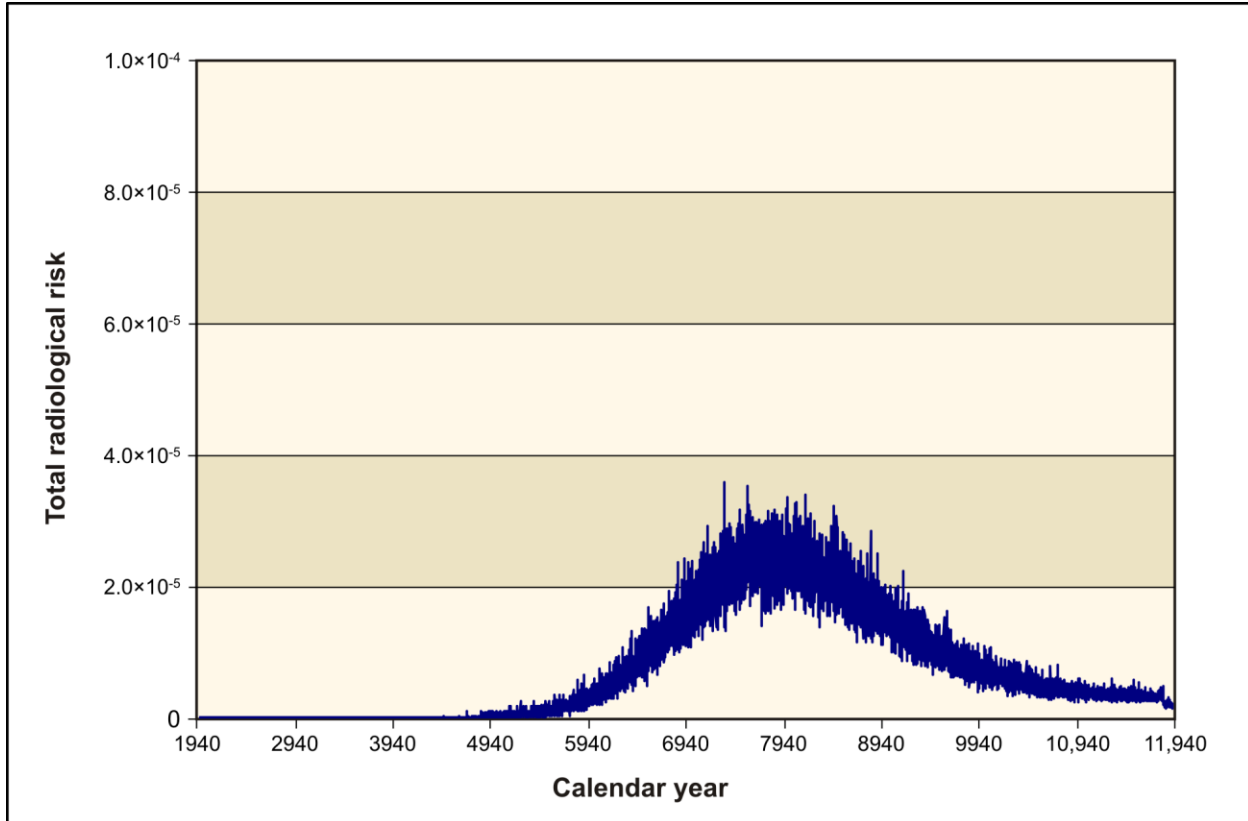


Figure 5–1142. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1143) does not include an early peak, as the RPPDF would not be constructed under this alternative, but does include a later peak due to sources at IDF-East.



**Figure 5-1143. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A,
Time Series of Radiological Risk for the Drinking-Water Well User
at the Core Zone Boundary**

5.3.2.2.9 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 2, Subgroup 2-B

Disposal Group 2, Subgroup 2-B, addresses the waste resulting from Tank Closure Alternative 6B (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-136 through 5-139. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, nitrate, and total uranium. For radionuclides, the dose standard would not be exceeded at any location. Under the Base Case, the Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Under the Option Case, the Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer due primarily to the presence of nitrate. In addition, the Hazard Index guideline would be exceeded at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated for Subgroup 2-B, Base Case, as 1.64×10^{-1} person-rem per year for the year of maximum impact and for Subgroup 2-B, Option Case, as 1.66×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.06×10^{-5} percent and 1.07×10^{-5} percent of the annual population dose due to background exposure under Subgroup 2-B, Base and Option Cases, respectively. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1144 and 5-1145 for the Base Case and in Figures 5-1146 and 5-1147 for the Option Case. The Base and Option Cases differ in the amounts of constituents disposed of

at the RPPDF because the Option Case includes removal of the Tank Closure alternative cribs and trenches (ditches). Estimates of impacts for IDF-East are the same for the two cases.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.5×10^{-4}) is due to release of radioactive constituents from offsite LLW. Under both the Base and Option Cases at the IDF-East barrier and the Core Zone Boundary, approximately 75 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents under the Base Case at both the IDF-East barrier and the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Option Case at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate from ETF-generated secondary waste (94 percent of Hazard Index) and chromium from tank closure secondary waste (6 percent of Hazard Index). For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary under the Base Case (see Figure 5–1145) and the Option Case (see Figure 5–1147) each comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East. The early peak is greater under the Option Case relative to the Base Case due to the inclusion of additional waste from cribs and trenches (ditches).

Table 5–136. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.03	1.82×10^{-1}	1.49×10^{-4}	0.00	1.49×10^{-4}	1.16×10^1	1.36	4.72×10^{-4}	7.73×10^{-12}	4.72×10^{-4}
River Protection Project Disposal Facility	3.26×10^{-1}	3.78×10^{-2}	9.96×10^{-6}	0.00	9.96×10^{-6}	7.68×10^{-1}	6.51×10^{-2}	3.17×10^{-5}	1.43×10^{-11}	3.17×10^{-5}
Core Zone Boundary	1.16	6.05×10^{-2}	3.57×10^{-5}	0.00	3.57×10^{-5}	2.75	4.44×10^{-1}	1.14×10^{-4}	1.34×10^{-11}	1.14×10^{-4}
Columbia River nearshore	7.66×10^{-1}	3.95×10^{-2}	2.39×10^{-5}	0.00	2.39×10^{-5}	1.83	3.02×10^{-1}	7.65×10^{-5}	8.03×10^{-12}	7.65×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.29×10^{-5}	5.38×10^{-6}	1.34×10^{-9}	1.64×10^{-16}	1.34×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–137. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.27×10^1	3.02	1.02×10^{-3}	3.55×10^{-7}	1.02×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.52	1.26×10^{-1}	6.86×10^{-5}	6.58×10^{-7}	6.91×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.44	9.87×10^{-1}	2.46×10^{-4}	6.13×10^{-7}	2.46×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.64	6.72×10^{-1}	1.66×10^{-4}	3.68×10^{-7}	1.66×10^{-4}	1.29×10^{-2}	1.01×10^{-1}	6.45×10^{-7}	3.68×10^{-7}	6.83×10^{-7}
Off Site										
Columbia River	1.23×10^{-4}	3.35×10^{-3}	4.52×10^{-9}	7.52×10^{-12}	4.52×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–138. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.07	2.78×10^{-1}	1.50×10^{-4}	0.00	1.50×10^{-4}	1.16×10^1	2.07	4.71×10^{-4}	8.83×10^{-12}	4.71×10^{-4}
River Protection Project Disposal Facility	4.70×10^{-1}	4.41×10^{-1}	1.42×10^{-5}	0.00	1.42×10^{-5}	1.10	1.61	4.50×10^{-5}	1.33×10^{-10}	4.50×10^{-5}
Core Zone Boundary	1.17	3.56×10^{-1}	3.57×10^{-5}	0.00	3.57×10^{-5}	2.75	1.22	1.14×10^{-4}	1.12×10^{-10}	1.14×10^{-4}
Columbia River nearshore	7.70×10^{-1}	2.34×10^{-1}	2.40×10^{-5}	0.00	2.40×10^{-5}	1.84	7.28×10^{-1}	7.69×10^{-5}	7.49×10^{-11}	7.69×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.32×10^{-5}	2.03×10^{-5}	1.35×10^{-9}	1.54×10^{-15}	1.35×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–139. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.28×10^1	4.60	1.02×10^{-3}	4.05×10^{-7}	1.02×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.16	3.43	9.75×10^{-5}	6.11×10^{-6}	1.01×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.44	2.57	2.46×10^{-4}	5.15×10^{-6}	2.46×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.66	1.52	1.67×10^{-4}	3.43×10^{-6}	1.67×10^{-4}	1.30×10^{-2}	2.82×10^{-1}	6.48×10^{-7}	3.43×10^{-6}	3.59×10^{-6}
Off Site										
Columbia River	1.24×10^{-4}	1.04×10^{-2}	4.54×10^{-9}	7.06×10^{-11}	4.54×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

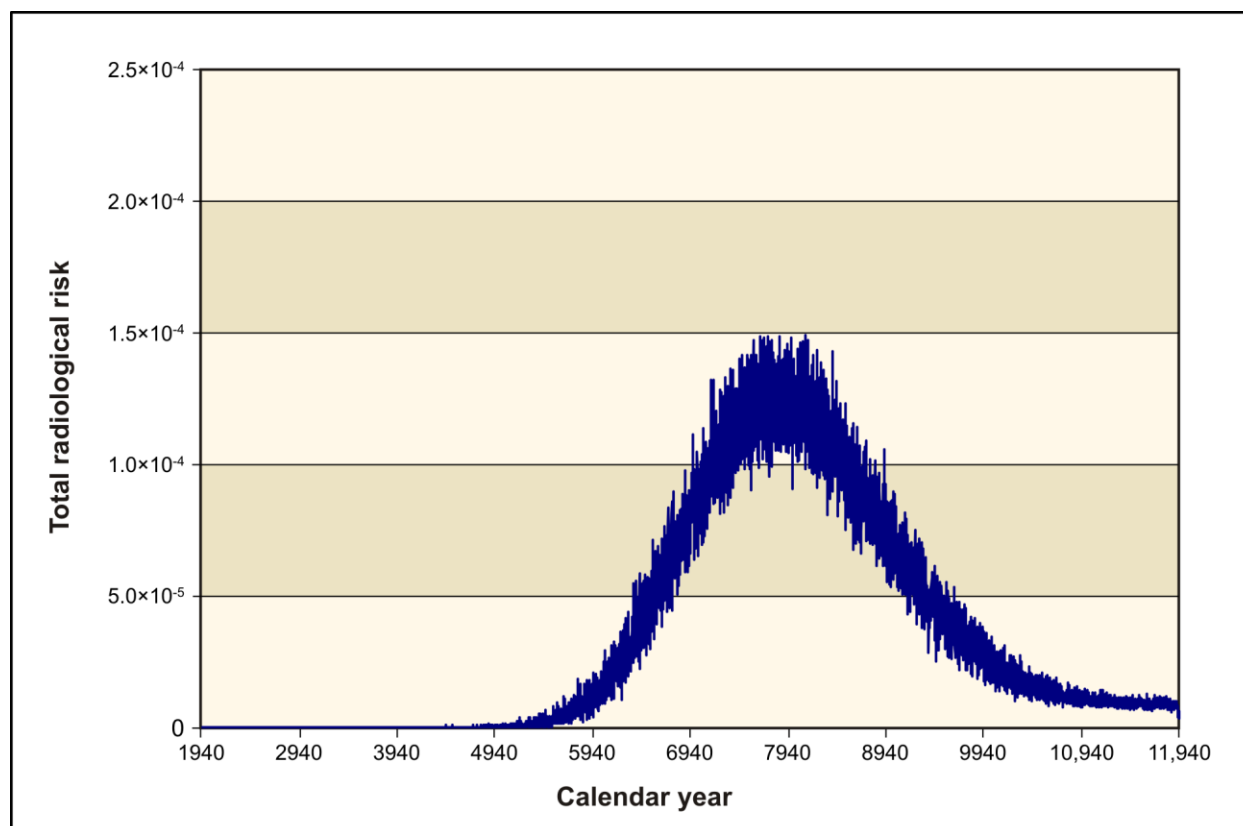


Figure 5–1144. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

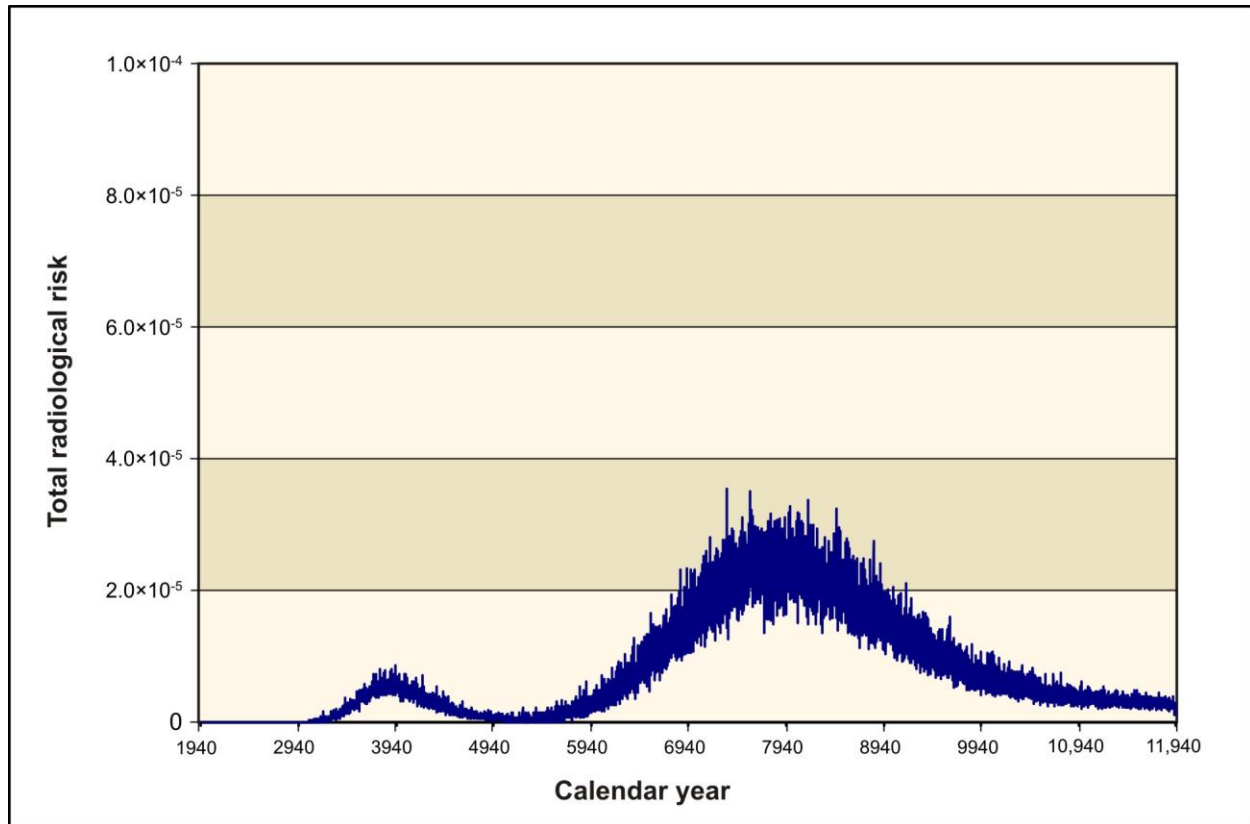


Figure 5–1145. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

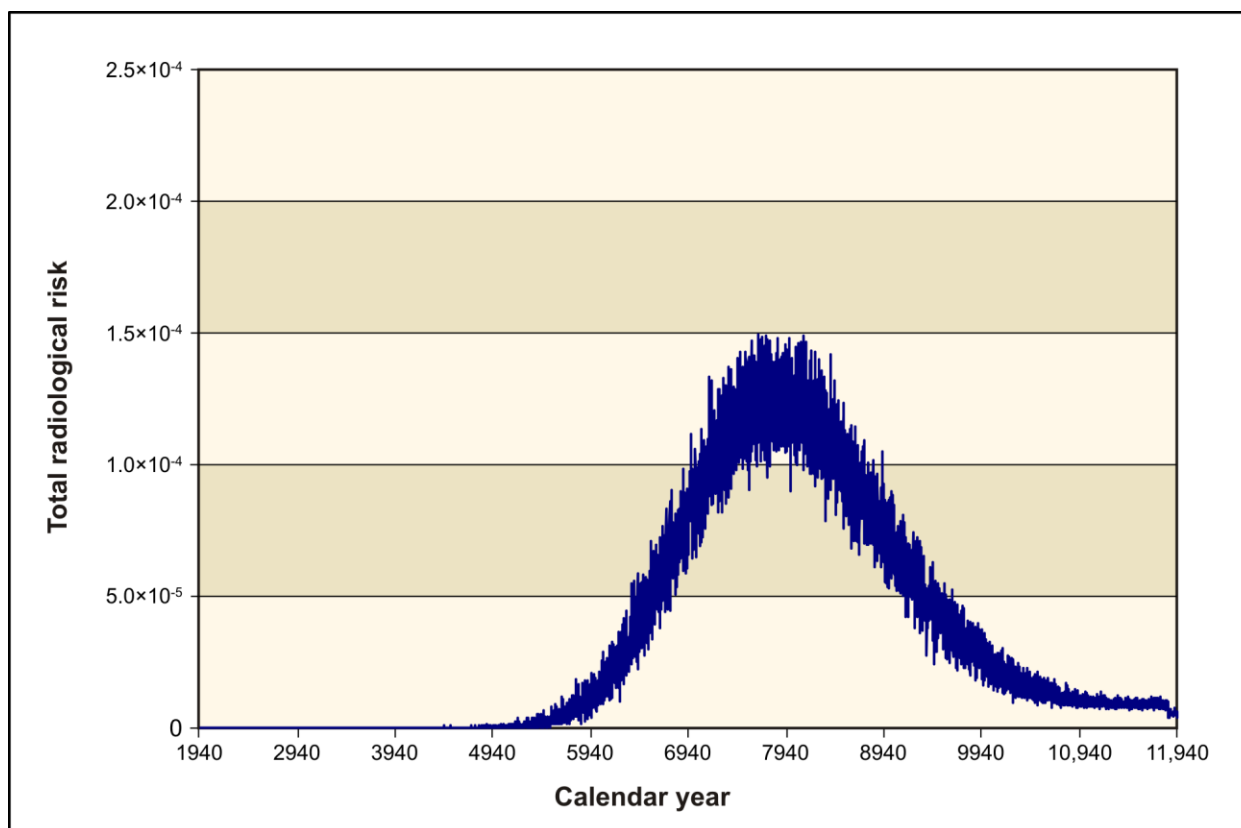


Figure 5–1146. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

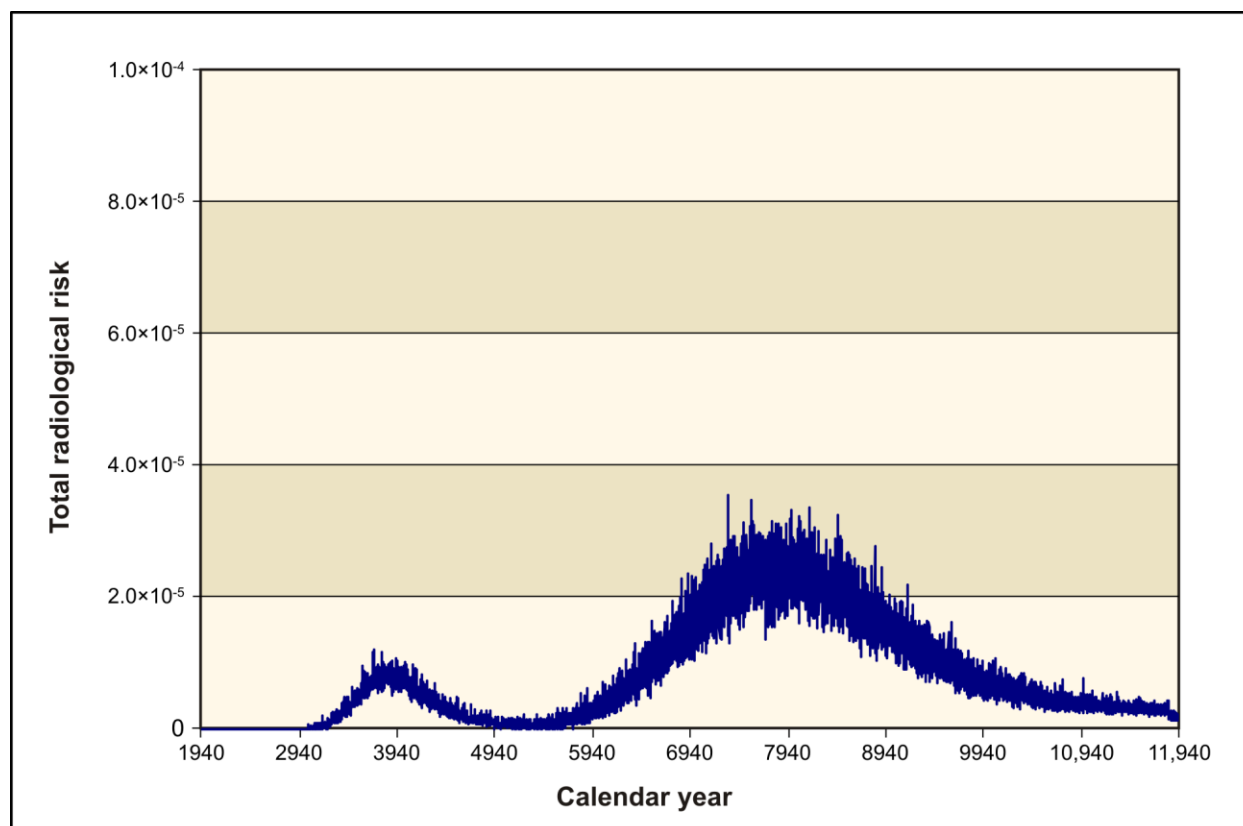


Figure 5-1147. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.10 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, Disposal Group 3

Disposal Group 3 addresses the waste resulting from Tank Closure Alternative 6A (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this disposal group.

Potential human health impacts of this alternative are summarized in Tables 5-140 through 5-143. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, nitrate, and total uranium. For radionuclides, the dose standard would not be exceeded at any location under both Base and Option Cases. Under the Base Case, the Hazard Index guidelines would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Under the Option Case, the Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer due primarily to the presence of chromium and nitrate. In addition, the Hazard Index guideline would be exceeded at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated for Disposal Group 3, Base Case, as 1.71×10^{-1} person-rem per year for the year of maximum impact and for Disposal Group 3, Option Case, as 1.73×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.10×10^{-5} percent and 1.11×10^{-5} percent of the annual population dose due to background exposure for Disposal Group 3, Base and Option Cases, respectively. The time series of lifetime radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in

Figures 5–1148 and 5–1149 for the Base Case and in Figures 5–1150 and 5–1151 for the Option Case. The Base and Option Cases differ in the amounts of constituents disposed of at the RPPDF because the Option Case includes removal of the Tank Closure alternative cribs and trenches (ditches). Estimates of impacts for IDF-East are the same for the two cases.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.6×10^{-4}) is due to release of radioactive constituents from offsite LLW. Under both the Base and Option Cases at the IDF-East barrier and the Core Zone Boundary, approximately 75 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents under the Base Case at both the IDF-East barrier and the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Option Case at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate from ETF-generated secondary waste (94 percent of Hazard Index) and chromium from tank closure secondary waste (6 percent of Hazard Index). For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary under the Base Case (see Figure 5–1149) and the Option Case (see Figure 5–1151) each comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East. The early peak is greater under the Option Case relative to the Base Case due to the inclusion of additional waste from cribs and trenches (ditches).

Table 5–140. Waste Management Alternative 2, Disposal Group 3, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.19	1.82×10^{-1}	1.57×10^{-4}	0.00	1.57×10^{-4}	1.21×10^1	1.36	4.99×10^{-4}	7.64×10^{-12}	4.99×10^{-4}
River Protection Project Disposal Facility	3.14×10^{-1}	3.92×10^{-2}	9.51×10^{-6}	0.00	9.51×10^{-6}	7.35×10^{-1}	7.03×10^{-2}	3.02×10^{-5}	1.48×10^{-11}	3.02×10^{-5}
Core Zone Boundary	1.21	6.05×10^{-2}	3.70×10^{-5}	0.00	3.70×10^{-5}	2.85	4.44×10^{-1}	1.18×10^{-4}	1.29×10^{-11}	1.18×10^{-4}
Columbia River nearshore	7.52×10^{-1}	3.96×10^{-2}	2.34×10^{-5}	0.00	2.34×10^{-5}	1.80	3.02×10^{-1}	7.50×10^{-5}	7.45×10^{-12}	7.50×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.42×10^{-5}	5.38×10^{-6}	1.40×10^{-9}	1.64×10^{-16}	1.40×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–141. Waste Management Alternative 2, Disposal Group 3, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.39×10^1	3.02	1.08×10^{-3}	3.50×10^{-7}	1.08×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.45	1.31×10^{-1}	6.53×10^{-5}	6.79×10^{-7}	6.58×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.63	9.87×10^{-1}	2.55×10^{-4}	5.90×10^{-7}	2.55×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.57	6.73×10^{-1}	1.63×10^{-4}	3.42×10^{-7}	1.63×10^{-4}	1.27×10^{-2}	1.01×10^{-1}	6.33×10^{-7}	3.41×10^{-7}	6.72×10^{-7}
Off Site										
Columbia River	1.28×10^{-4}	3.35×10^{-3}	4.71×10^{-9}	7.54×10^{-12}	4.71×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–142. Waste Management Alternative 2, Disposal Group 3, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.22	2.78×10^{-1}	1.56×10^{-4}	0.00	1.56×10^{-4}	1.21×10^1	2.07	4.96×10^{-4}	8.82×10^{-12}	4.96×10^{-4}
River Protection Project Disposal Facility	4.75×10^{-1}	4.39×10^{-1}	1.49×10^{-5}	0.00	1.49×10^{-5}	1.14	1.53	4.77×10^{-5}	1.27×10^{-10}	4.77×10^{-5}
Core Zone Boundary	1.17	3.75×10^{-1}	3.66×10^{-5}	0.00	3.66×10^{-5}	2.81	1.33	1.17×10^{-4}	1.12×10^{-10}	1.17×10^{-4}
Columbia River nearshore	7.65×10^{-1}	2.58×10^{-1}	2.37×10^{-5}	0.00	2.37×10^{-5}	1.82	8.37×10^{-1}	7.58×10^{-5}	8.15×10^{-11}	7.58×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.45×10^{-5}	2.02×10^{-5}	1.41×10^{-9}	1.52×10^{-15}	1.41×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–143. Waste Management Alternative 2, Disposal Group 3, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.38×10^1	4.60	1.07×10^{-3}	4.05×10^{-7}	1.07×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.27	3.24	1.04×10^{-4}	5.82×10^{-6}	1.07×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.58	2.79	2.54×10^{-4}	5.12×10^{-6}	2.54×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.61	1.79	1.64×10^{-4}	3.74×10^{-6}	1.64×10^{-4}	1.28×10^{-2}	2.86×10^{-1}	6.39×10^{-7}	3.74×10^{-6}	3.91×10^{-6}
Off Site										
Columbia River	1.29×10^{-4}	1.03×10^{-2}	4.71×10^{-9}	6.98×10^{-11}	4.71×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

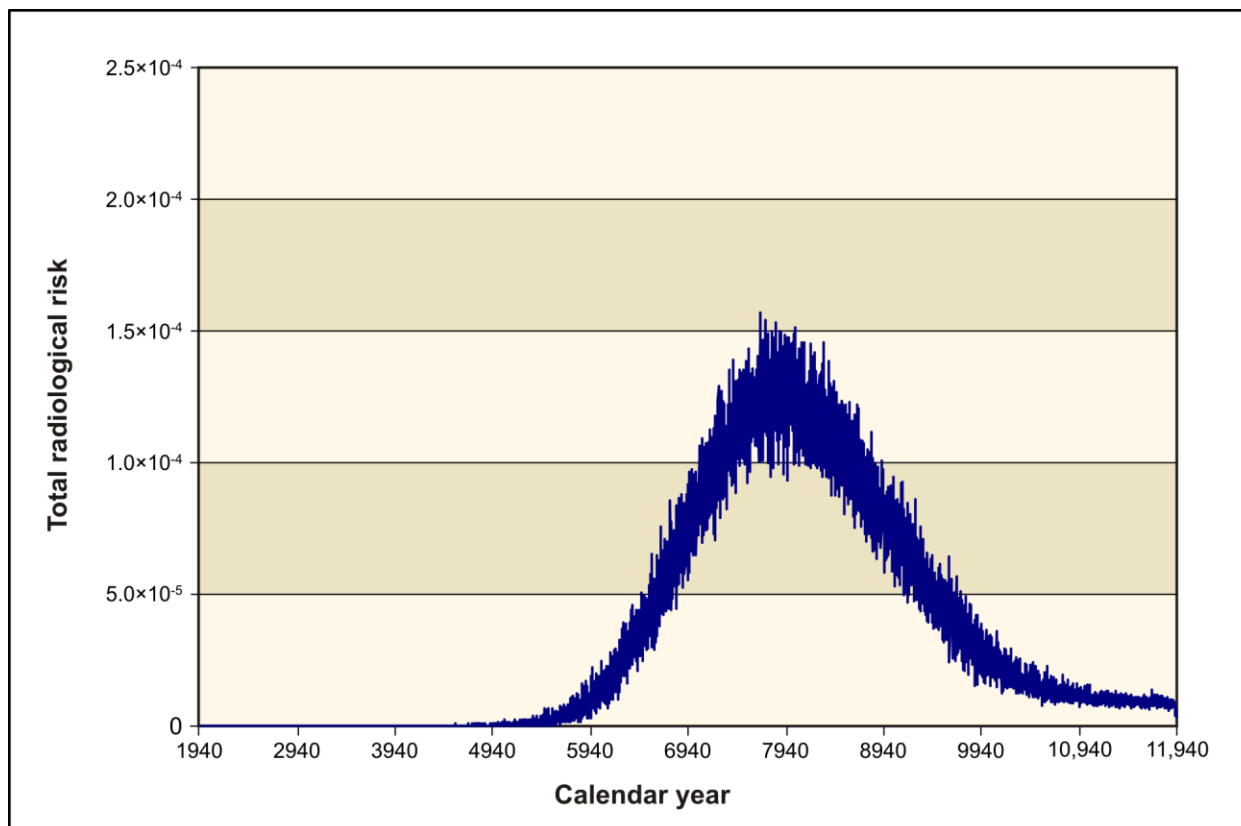


Figure 5–1148. Waste Management Alternative 2, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

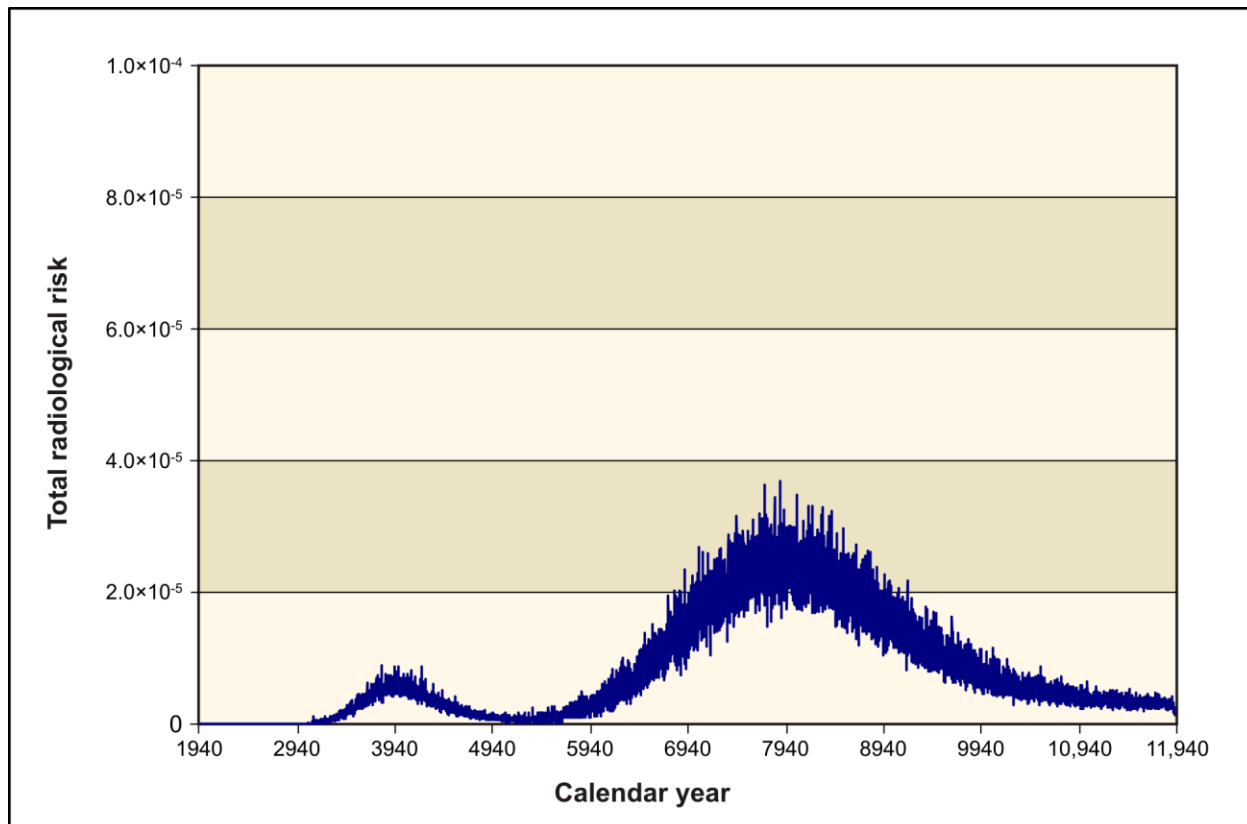


Figure 5–1149. Waste Management Alternative 2, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

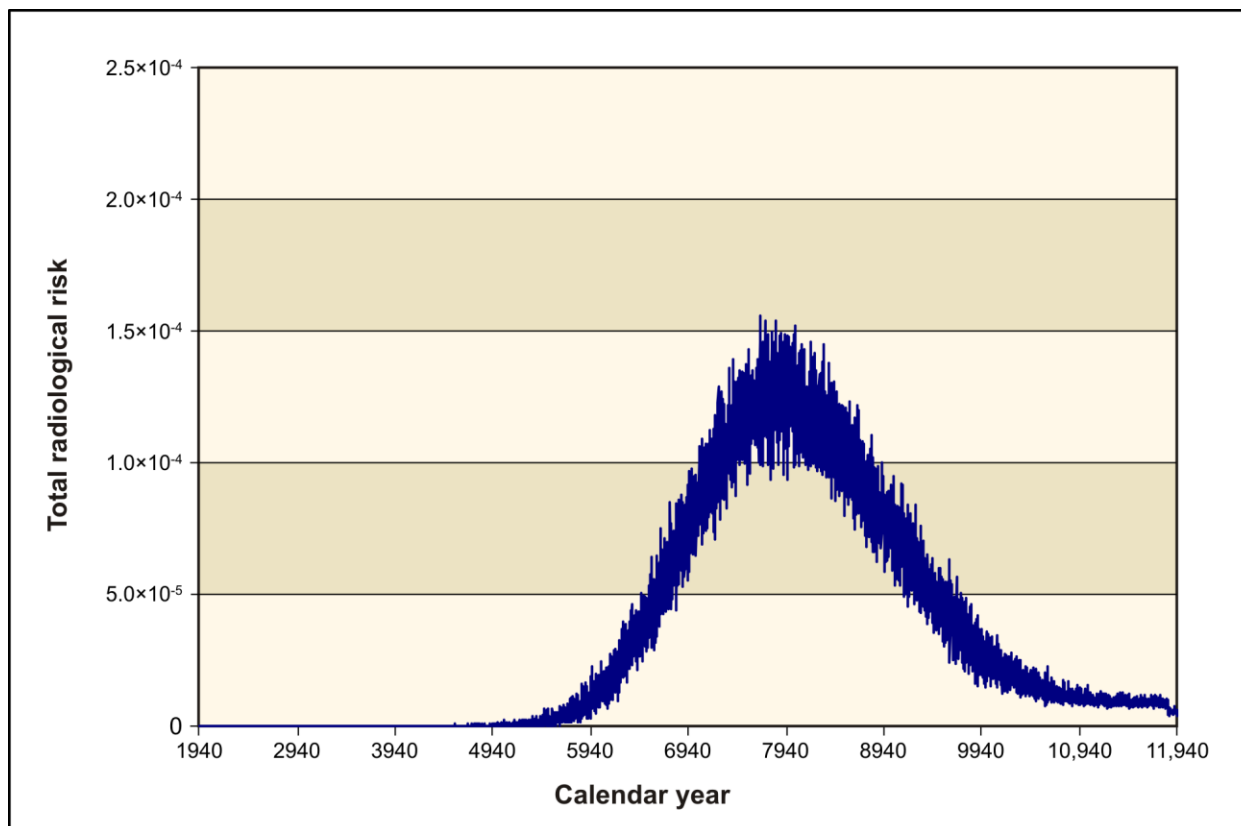


Figure 5–1150. Waste Management Alternative 2, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

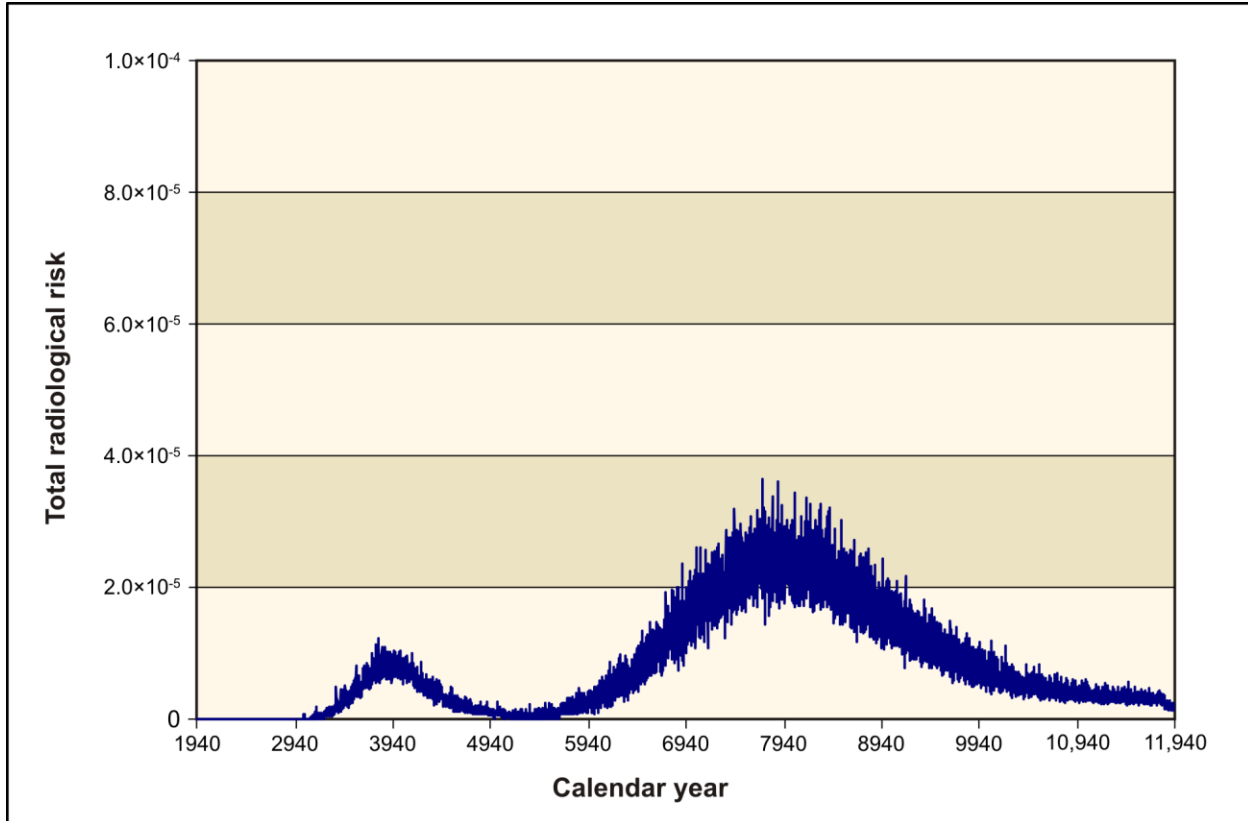


Figure 5-1151. Waste Management Alternative 2, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

Under Waste Management Alternative 3, the waste from tank treatment operations would be disposed of in IDF-East, and the waste from onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-West. Waste from tank farm cleanup operations would be disposed of in the RPPDF. As a result, the waste disposed of in these three facilities would become available for release to the environment. Because of the different waste types that result from the Tank Closure action alternatives, three disposal groups were considered to account for the different sizes and operational time periods of IDF-East. In addition, within these three disposal groups, subgroups were identified to allow consideration of the different waste types resulting from the Tank Closure alternatives. Potential human health impacts of these subgroups under this alternative are discussed in the following sections.

5.3.2.3.1 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-A

Disposal Group 1, Subgroup 1-A, addresses the waste resulting from Tank Closure Alternative 2B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-144 and 5-145. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129. The key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index would be exceeded at the IDF-East barrier for the resident farmer and

American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary are presented in Figures 5–1152, 5–1153, and 5–1154, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.4×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from tank closure secondary waste (59 percent of peak dose) and iodine-129 from ETF-generated secondary waste (41 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (4 percent of Hazard Index) and nitrate from ETF-generated secondary waste (96 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (7 percent of Hazard Index) and nitrate from ETF-generated secondary waste (93 percent of Hazard Index).

Releases from ILAW glass contribute a minor portion of the risk. At IDF-West, the peak of the time-averaged lifetime radiological risk (8.6×10^{-4}) is due primarily to release of technetium-99 from offsite LLW. At the IDF-West barrier, estimates of noncarcinogenic impacts are low (Hazard Index of 0.01) and are due to release of chromium from offsite LLW. For the time series of risk at the Core Zone Boundary (see Figure 5–1154), the large, early peak in CY 3700 is due to releases from IDF-West, while the lower peak in CY 9900 is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–144. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

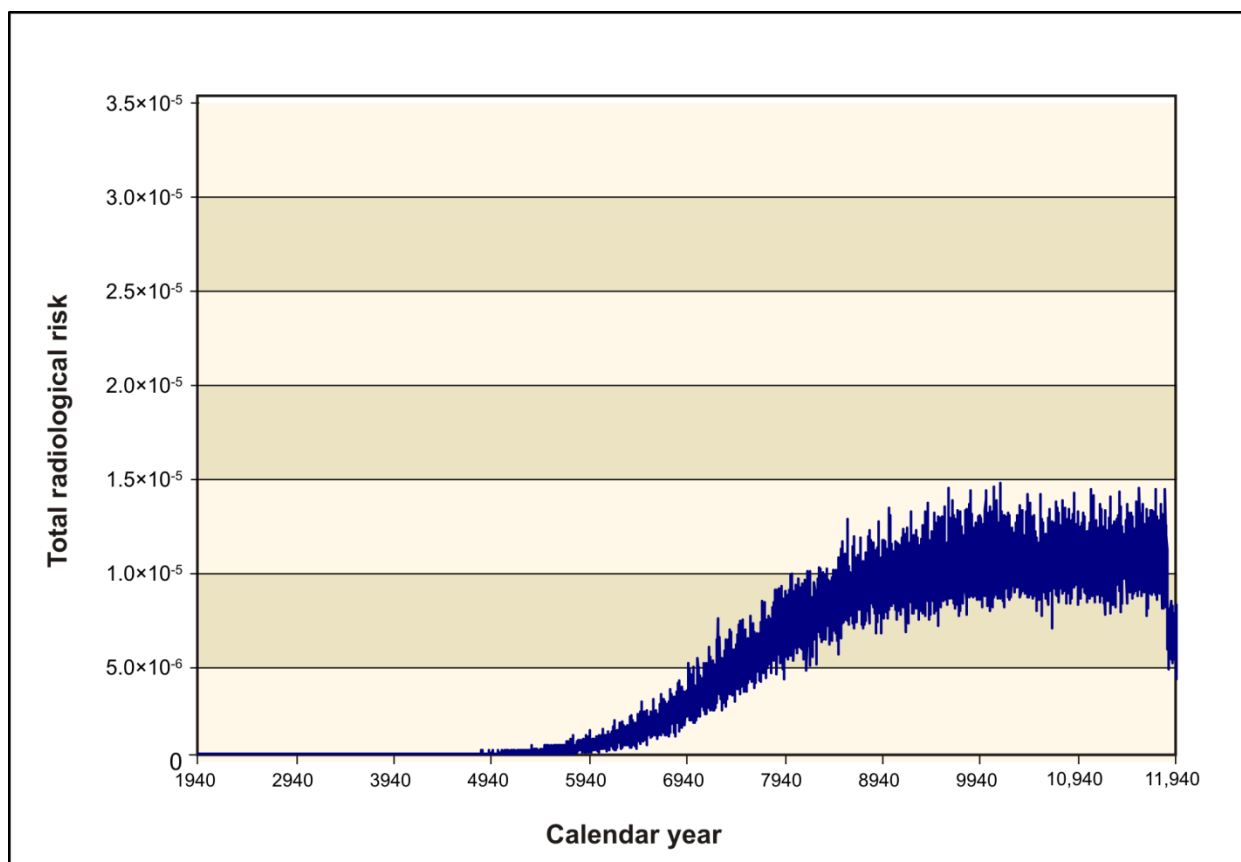
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.64×10^{-1}	2.29×10^{-1}	1.44×10^{-5}	0.00	1.44×10^{-5}	1.15	1.71	4.39×10^{-5}	8.22×10^{-12}	4.39×10^{-5}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	5.76×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.27×10^{-1}	2.81×10^{-4}	2.94×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	3.77×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.87×10^{-1}	3.41×10^{-4}	1.87×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	5.67×10^{-6}	2.79×10^{-9}	0.00	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

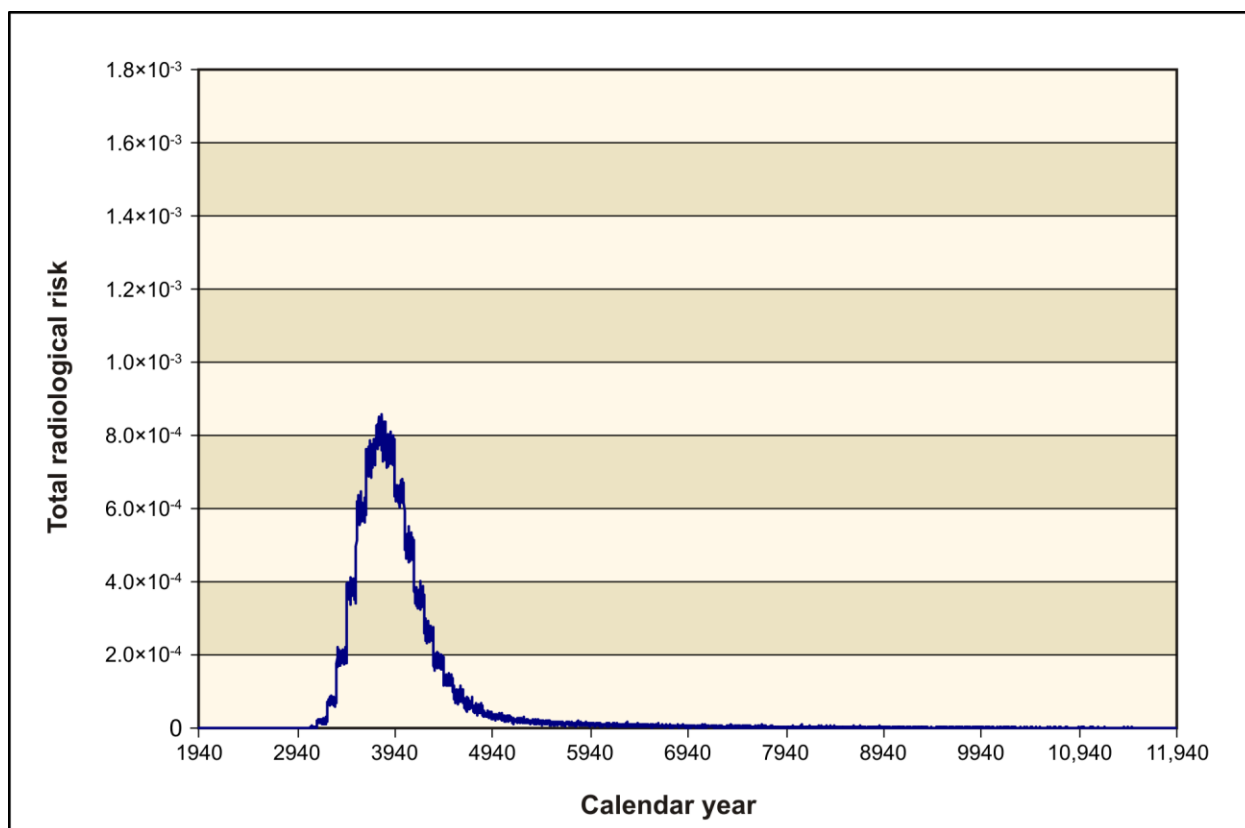
Table 5–145. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.18	3.81	9.38×10^{-5}	3.77×10^{-7}	9.39×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	9.49×10^{-1}	6.09×10^{-4}	1.35×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	6.39×10^{-1}	7.39×10^{-4}	8.57×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	1.01×10^{-1}	2.85×10^{-6}	8.56×10^{-8}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.53×10^{-3}	9.31×10^{-9}	0.00	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1152. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**



**Figure 5–1153. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-West Area Integrated Disposal Facility Barrier**

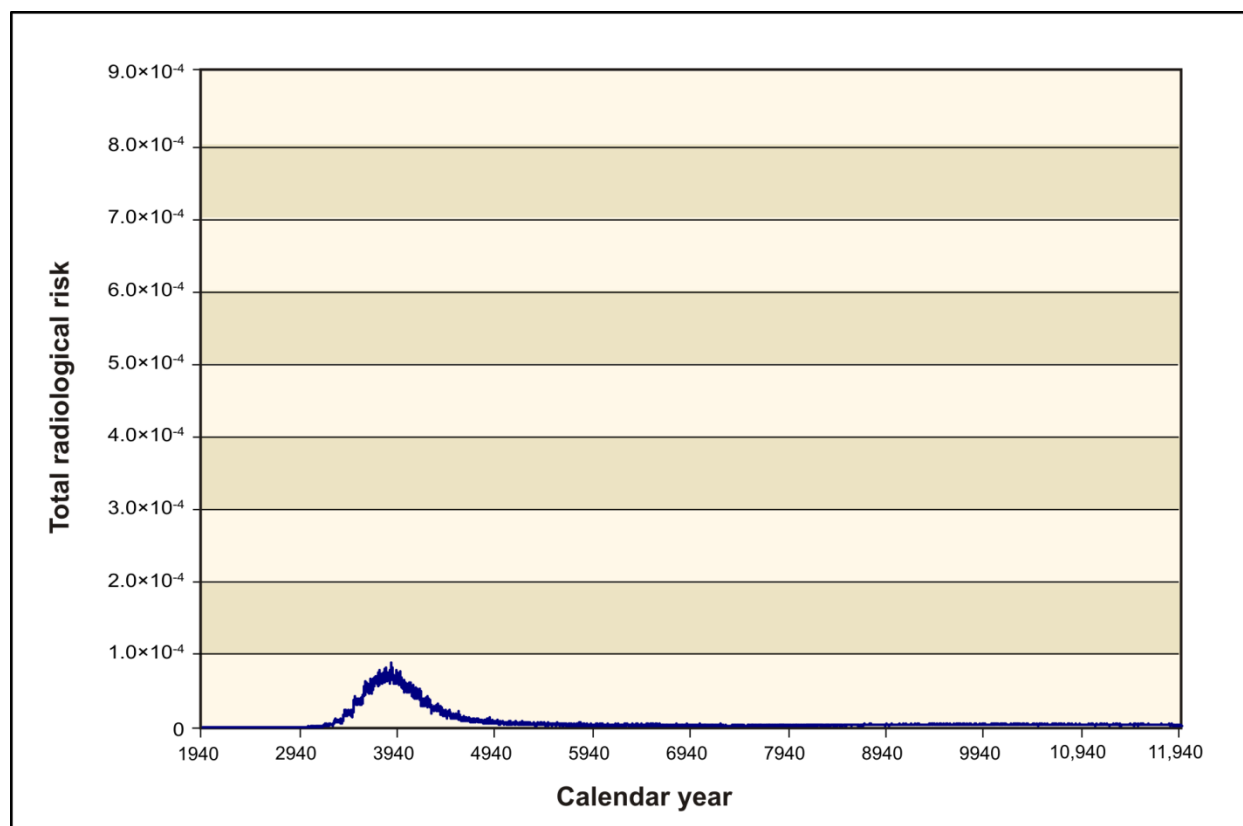


Figure 5-1154. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.2 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-B

Disposal Group 1, Subgroup 1-B, addresses the waste resulting from Tank Closure Alternative 3A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-146 and 5-147. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129. The key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1155 and 5-1156, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5-1153, and peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.7×10^{-5}) is due to release of radioactive constituents from bulk vitrification glass. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from bulk vitrification glass (97 percent of peak

dose) and iodine-129 from ETF-generated secondary waste (3 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (3 percent of Hazard Index) and nitrate from ETF-generated secondary waste (97 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (67 percent of Hazard Index) and nitrate from ETF-generated secondary waste (33 percent of Hazard Index).

The major contributor to risk for the bulk vitrification glass is release of technetium-99 from the castable refractory block portion of the waste form package. For the time series of risk at the Core Zone Boundary (see Figure 5–1156), the large, early peak in CY 3700 is due to releases from IDF-West, while the low plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–146. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

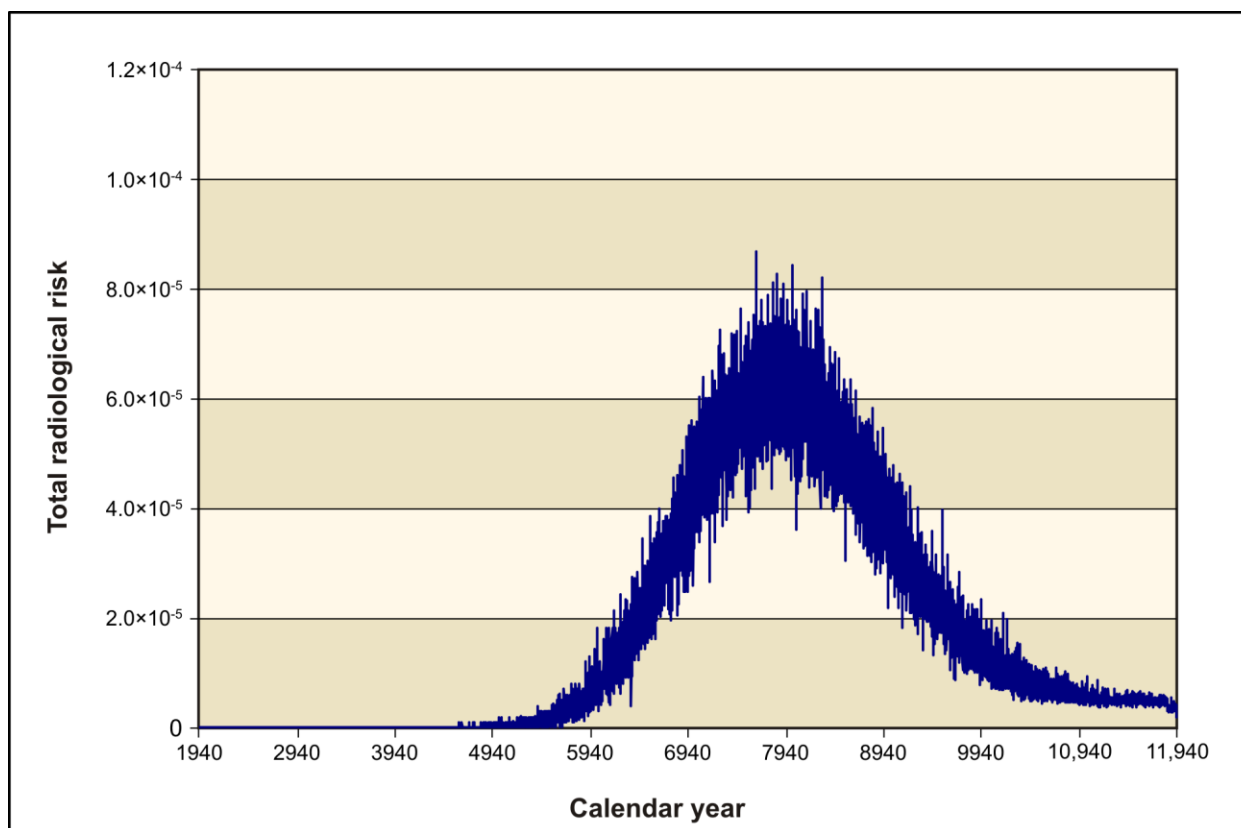
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.59	1.89×10^{-1}	8.70×10^{-5}	0.00	8.70×10^{-5}	6.55	1.45	2.84×10^{-4}	3.72×10^{-12}	2.84×10^{-4}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	5.15×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	3.94×10^{-1}	2.81×10^{-4}	2.94×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	4.04×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	3.11×10^{-1}	3.41×10^{-4}	1.87×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	5.11×10^{-6}	2.79×10^{-9}	0.00	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–147. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.33×10^1	3.22	6.21×10^{-4}	1.71×10^{-7}	6.21×10^{-4}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	8.77×10^{-1}	6.09×10^{-4}	1.35×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	6.92×10^{-1}	7.39×10^{-4}	8.57×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	1.01×10^{-1}	2.85×10^{-6}	8.56×10^{-8}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.18×10^{-3}	9.31×10^{-9}	0.00	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1155. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

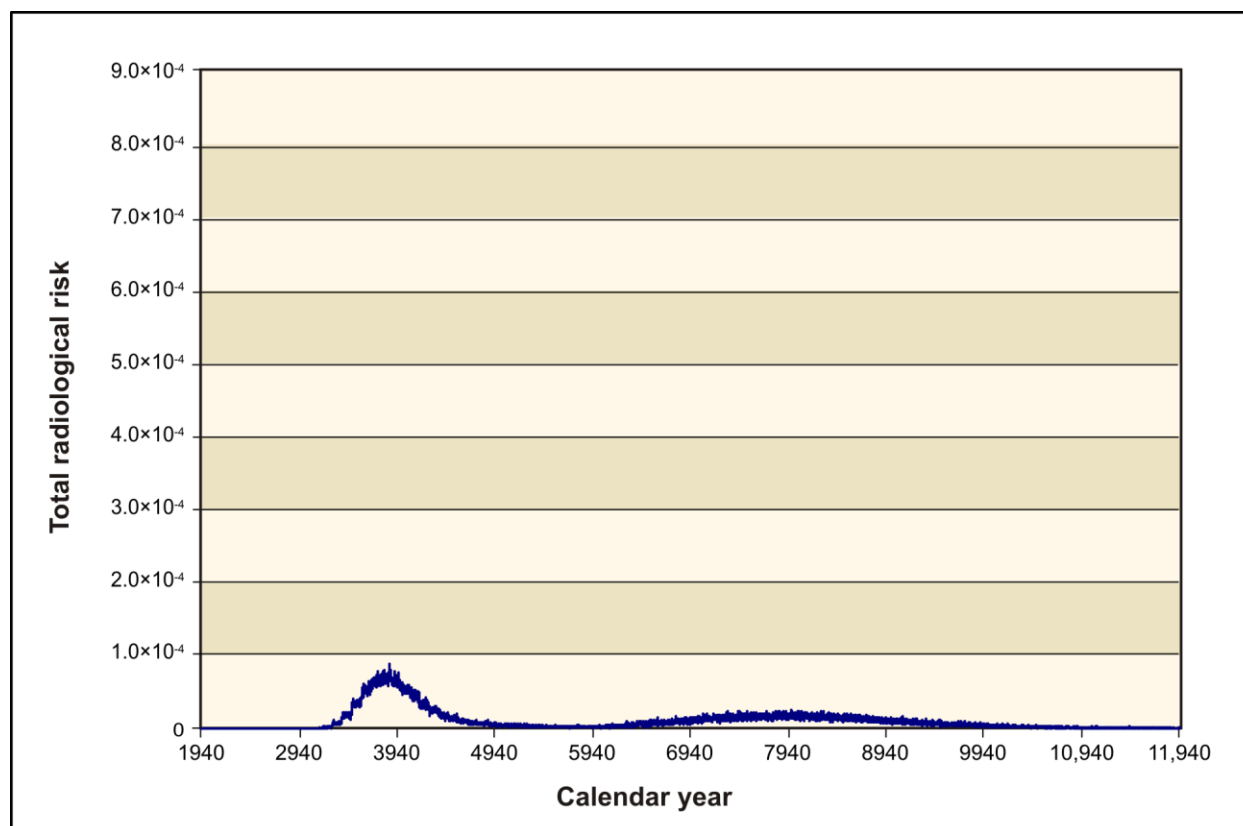


Figure 5-1156. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-C

Disposal Group 1, Subgroup 1-C, addresses the waste resulting from Tank Closure Alternative 3B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-148 and 5-149. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user, resident farmer, and American Indian resident farmer. The Hazard Index guideline would also be exceeded at the Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1157 and 5-1158, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5-1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.8×10^{-4}) is due to release of radioactive constituents from cast stone waste. At the IDF-East barrier, the dose in the

year of peak dose is due to technetium-99 released from cast stone waste (99 percent of peak dose) and iodine-129 from ETF-generated secondary waste (1 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium (84 percent of Hazard Index) and nitrate (16 percent of Hazard Index) from cast stone waste. For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (88 percent of Hazard Index) and nitrate (12 percent of Hazard Index) from cast stone waste.

For the time series of risk at the Core Zone Boundary (see Figure 5–1158), the large, early peak in CY 3700 is due to releases from IDF-West, while the low plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–148. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

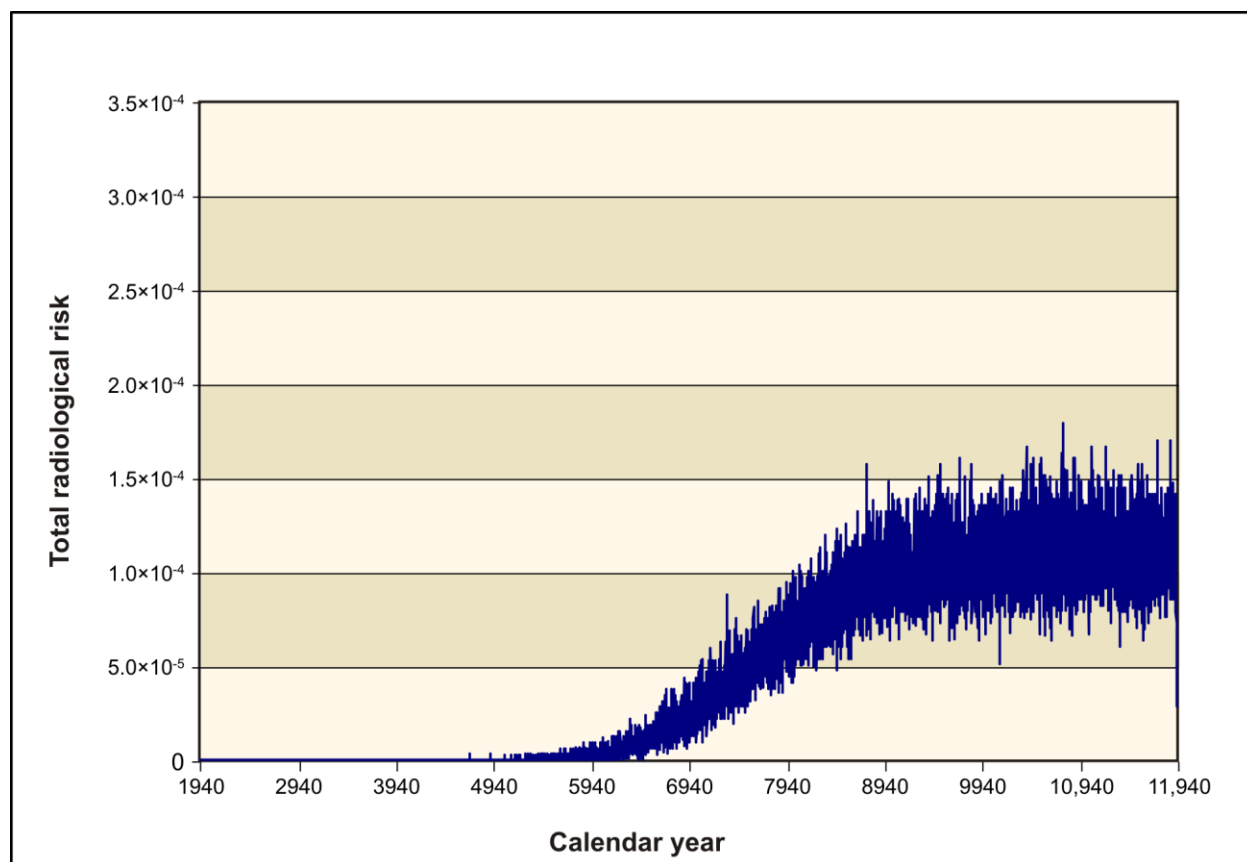
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.27	3.39	1.80×10^{-4}	0.00	1.80×10^{-4}	1.35×10^1	8.38	5.89×10^{-4}	1.16×10^{-9}	5.89×10^{-4}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	1.11	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	3.03	2.81×10^{-4}	3.99×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	8.56×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.17	3.41×10^{-4}	3.08×10^{-10}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	3.95×10^{-5}	2.79×10^{-9}	4.59×10^{-15}	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–149. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.75×10^1	1.70×10^1	1.29×10^{-3}	5.32×10^{-5}	1.30×10^{-3}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	6.20	6.09×10^{-4}	1.83×10^{-5}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	4.37	7.39×10^{-4}	1.41×10^{-5}	7.39×10^{-4}	5.72×10^{-2}	8.18×10^{-1}	2.85×10^{-6}	1.41×10^{-5}	1.46×10^{-5}
Off Site										
Columbia River	2.51×10^{-4}	1.80×10^{-2}	9.31×10^{-9}	2.10×10^{-10}	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1157. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

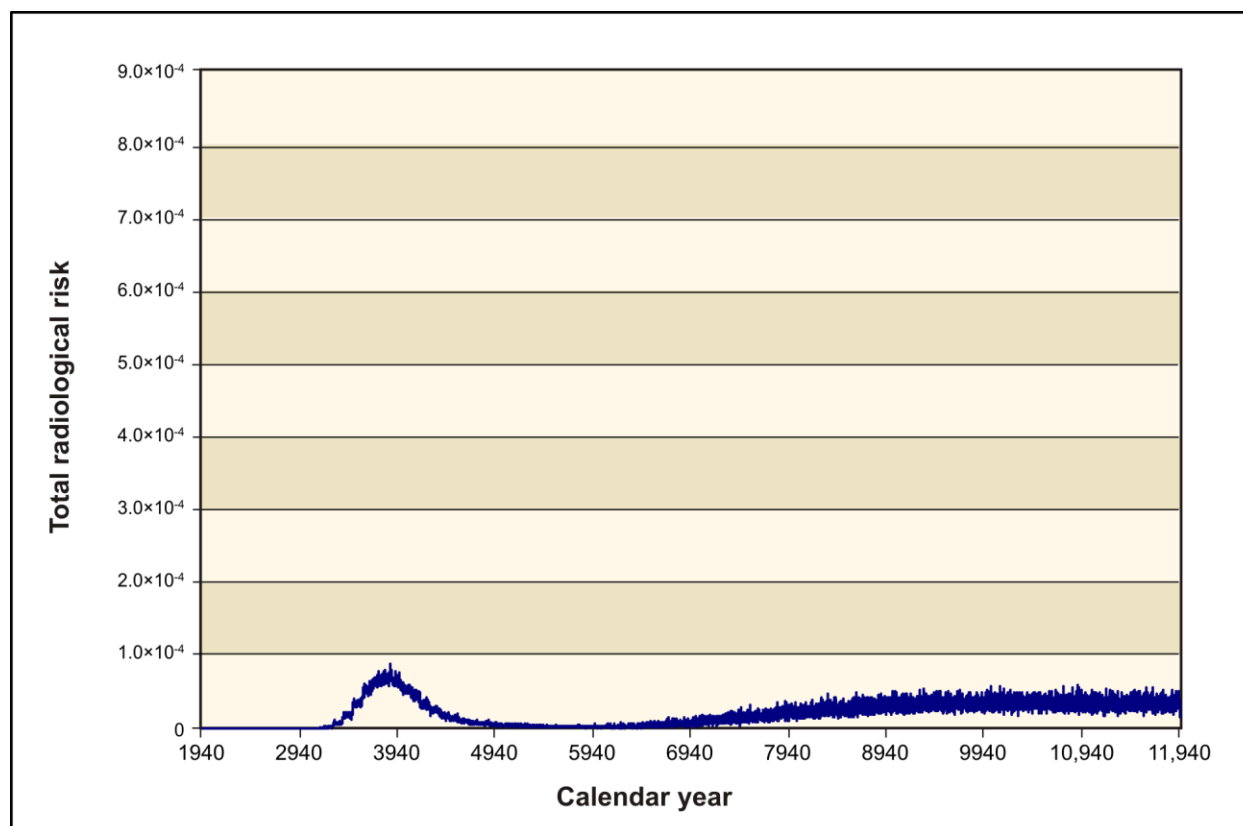


Figure 5-1158. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.4 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-D

Disposal Group 1, Subgroup 1-D, addresses the waste resulting from Tank Closure Alternative 3C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-150 and 5-151. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index would be exceeded due primarily to nitrate at the IDF-East barrier for the resident farmer and American Indian resident farmer. The Hazard Index guideline would also be exceeded at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1159 and 5-1160, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5-1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (7.3×10^{-5}) is due to release of radioactive constituents from steam reforming waste. At the IDF-East barrier, the dose

in the year of peak dose is due to release of technetium-99 from steam reforming waste (89 percent of peak dose) and iodine-129 from ETF-generated secondary waste (11 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from steam reforming waste (33 percent of Hazard Index) and nitrate from ETF-generated secondary waste (67 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from steam reforming waste (43 percent of Hazard Index) and nitrate from ETF-generated secondary waste (57 percent of Hazard Index).

For the time series of risk at the Core Zone Boundary (see Figure 5–1160), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent peak in CY 8000 is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–150. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

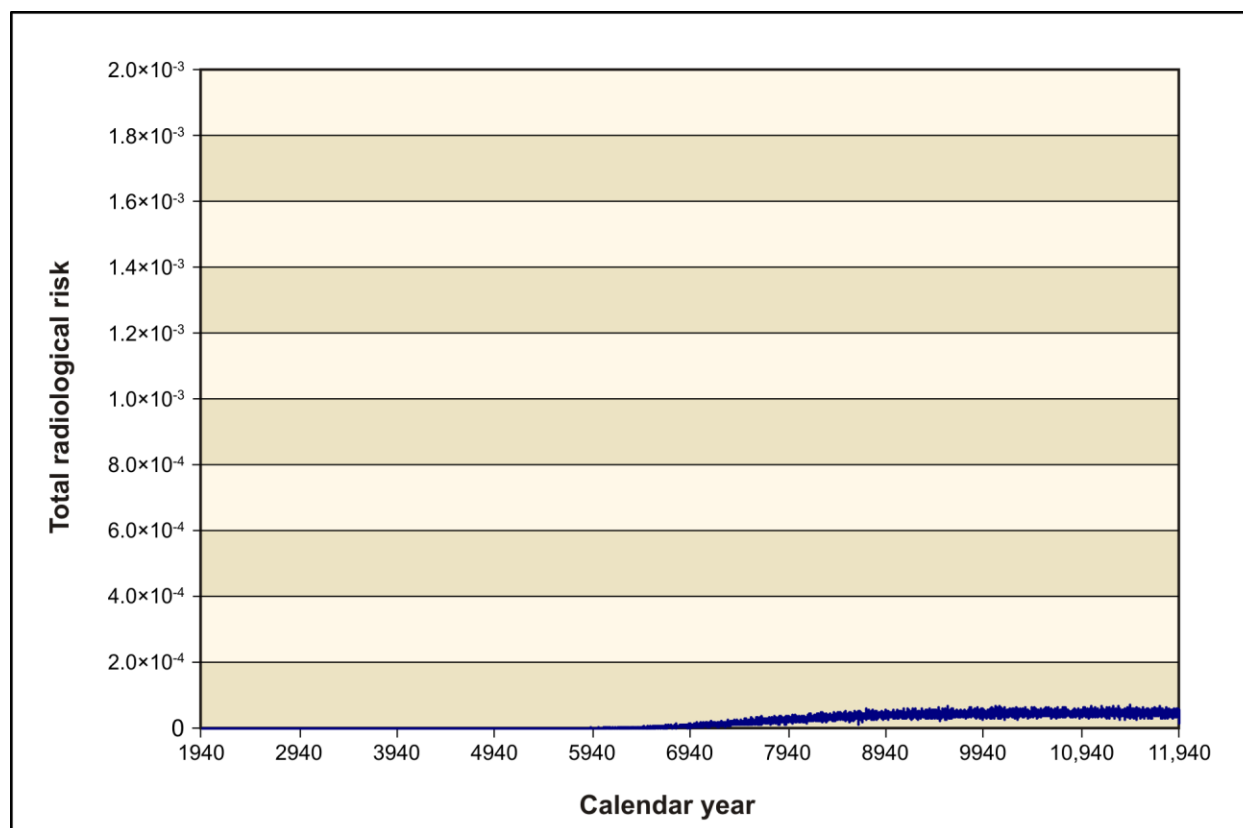
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.28	3.04×10^{-1}	7.26×10^{-5}	0.00	7.26×10^{-5}	5.54	1.71	2.34×10^{-4}	7.57×10^{-11}	2.34×10^{-4}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	9.23×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.66×10^{-1}	2.81×10^{-4}	2.38×10^{-11}	2.81×10^{-4}
Columbia River nearshore	3.52	6.35×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	3.57×10^{-1}	3.41×10^{-4}	1.83×10^{-11}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	6.26×10^{-6}	2.79×10^{-9}	2.90×10^{-16}	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–151. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.11×10^1	3.74	5.08×10^{-4}	3.47×10^{-6}	5.10×10^{-4}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	1.02	6.09×10^{-4}	1.09×10^{-6}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	7.82×10^{-1}	7.39×10^{-4}	8.39×10^{-7}	7.39×10^{-4}	5.72×10^{-2}	1.20×10^{-1}	2.85×10^{-6}	8.38×10^{-7}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.68×10^{-3}	9.31×10^{-9}	1.33×10^{-11}	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5-1159. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

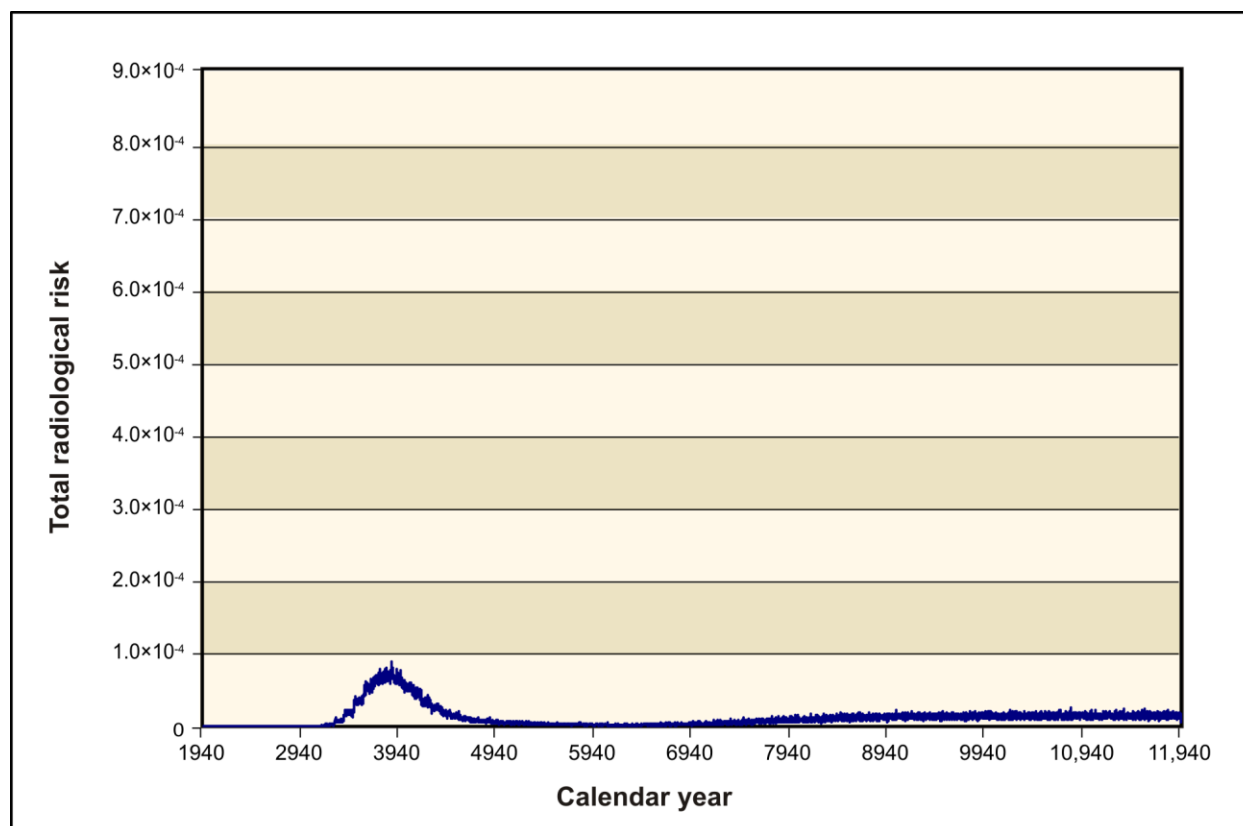


Figure 5–1160. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.5 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-E

Disposal Group 1, Subgroup 1-E, addresses the waste resulting from Tank Closure Alternative 4, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–152 and 5–153. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer and at the Core Zone Boundary and Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.46×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.23×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1161 and 5–1162, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153, and peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (2.3×10^{-4}) is due to release of radioactive constituents from cast stone waste. At the IDF-East barrier, the dose in the

year of peak dose is due to technetium-99 released from cast stone waste (98 percent of peak dose) and iodine-129 from ETF-generated secondary waste (2 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium (82 percent of Hazard Index) and nitrate (14 percent of Hazard Index) from cast stone waste. For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (81 percent of Hazard Index) and nitrate (19 percent of Hazard Index) from cast stone waste.

For the time series of risk at the Core Zone Boundary (see Figure 5–1162), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–152. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

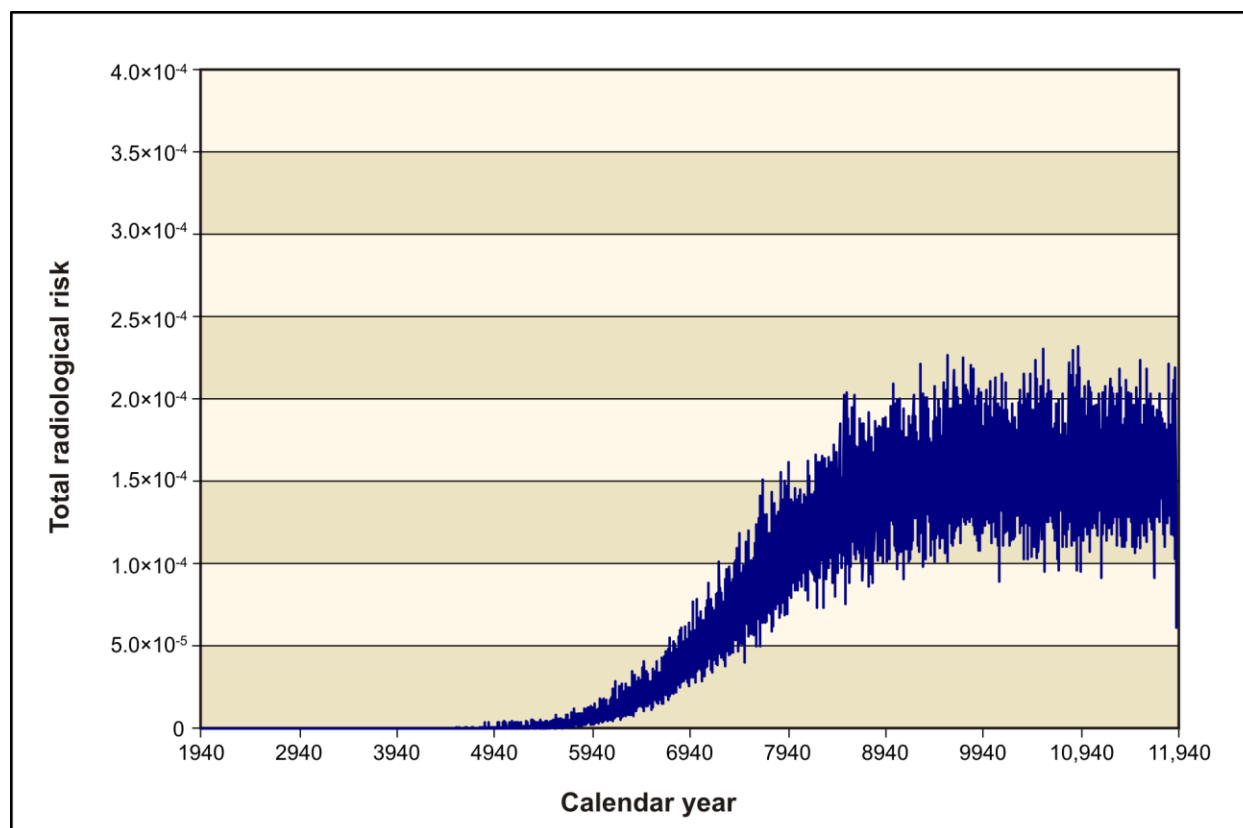
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	6.84	2.08	2.32×10^{-4}	0.00	2.32×10^{-4}	1.75×10^1	5.14	7.62×10^{-4}	6.88×10^{-10}	7.62×10^{-4}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	2.37×10^{-1}	6.92×10^{-2}	7.01×10^{-6}	0.00	7.01×10^{-6}	5.45×10^{-1}	1.01×10^{-1}	2.21×10^{-5}	2.69×10^{-11}	2.21×10^{-5}
Core Zone Boundary	2.92	6.26×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.63	2.81×10^{-4}	2.06×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	4.68×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	1.16	3.41×10^{-4}	1.56×10^{-10}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.92×10^{-5}	2.32×10^{-5}	2.86×10^{-9}	2.58×10^{-15}	2.86×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–153. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.55×10^1	1.04×10^1	1.66×10^{-3}	3.15×10^{-5}	1.67×10^{-3}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.07	1.78×10^{-1}	4.77×10^{-5}	1.23×10^{-6}	4.86×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	3.32	6.09×10^{-4}	9.45×10^{-6}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	2.43	7.39×10^{-4}	7.17×10^{-6}	7.39×10^{-4}	5.72×10^{-2}	4.29×10^{-1}	2.85×10^{-6}	7.16×10^{-6}	7.81×10^{-6}
Off Site										
Columbia River	2.55×10^{-4}	1.09×10^{-2}	9.46×10^{-9}	1.18×10^{-10}	9.46×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1161. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

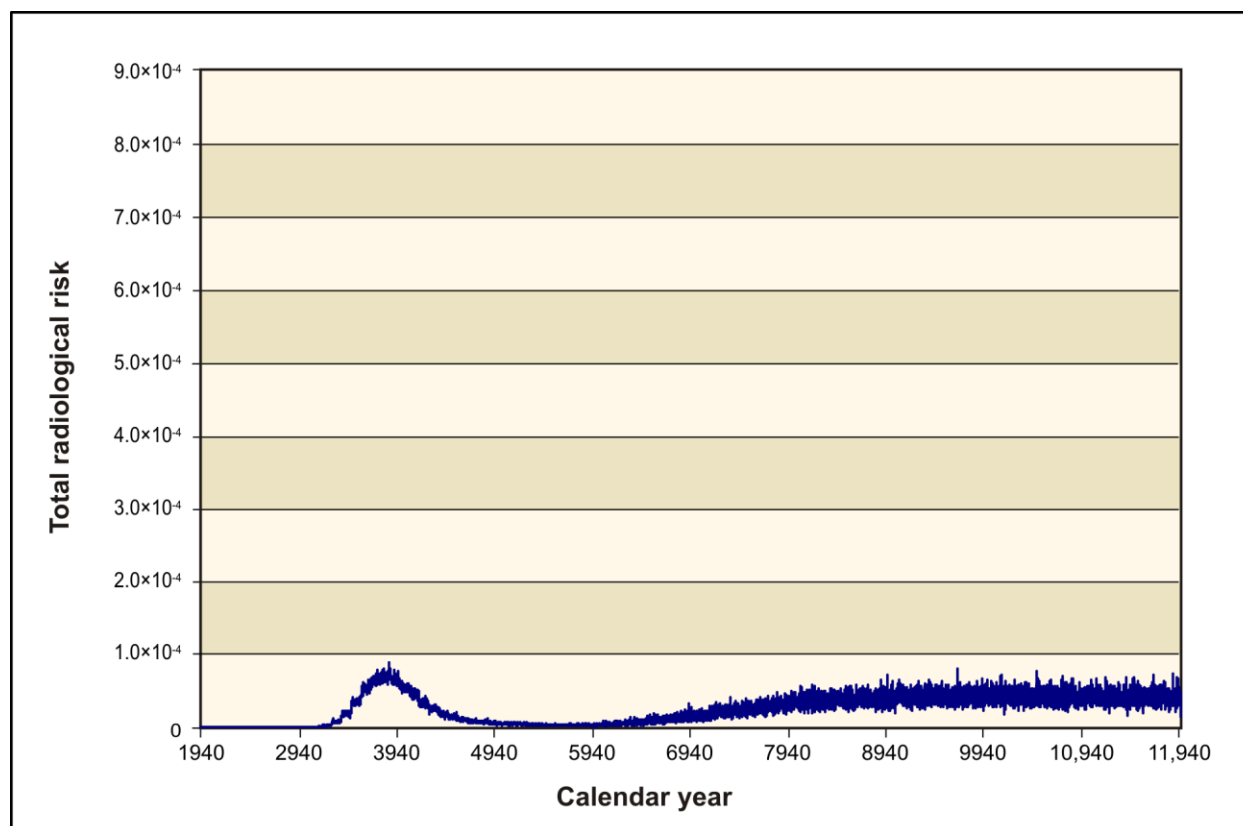


Figure 5–1162. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.6 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-F

Disposal Group 1, Subgroup 1-F, addresses the waste resulting from Tank Closure Alternative 5, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–154 and 5–155. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer. The Hazard Index guideline would also be exceeded at the Core Zone Boundary for the resident farmer and American Indian resident farmer and would be exceeded at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.18×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1163 and 5–1164, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.5×10^{-5}) is due to release of radioactive constituents from cast stone waste and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from cast stone waste (96 percent of peak dose) and iodine-129 from ETF-generated secondary waste (4 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium (93 percent of Hazard Index) from sulfate grout and nitrate (7 percent of Hazard Index) from ETF-generated secondary waste. For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (91 percent of Hazard Index) from sulfate grout and nitrate (9 percent of Hazard Index) from ETF-generated secondary waste.

For the time series of risk at the Core Zone Boundary (see Figure 5–1164), the large early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. The RPPDF would not be constructed under this alternative.

Table 5–154. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

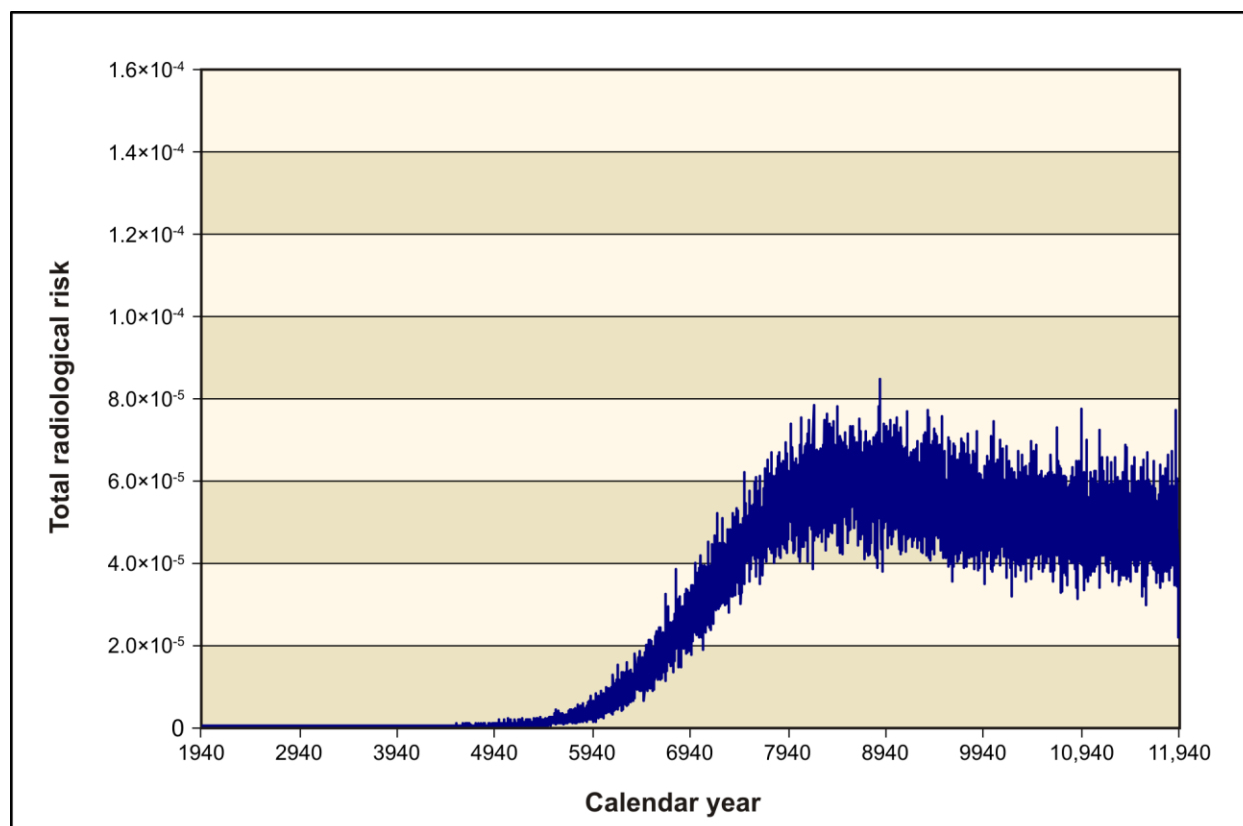
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.53	3.03	8.45×10^{-5}	0.00	8.45×10^{-5}	6.38	4.98	2.76×10^{-4}	1.16×10^{-9}	2.76×10^{-4}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	2.92	8.20×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.45	2.81×10^{-4}	3.06×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	6.11×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	9.75×10^{-1}	3.41×10^{-4}	2.34×10^{-10}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.78×10^{-5}	2.07×10^{-5}	2.77×10^{-9}	4.03×10^{-15}	2.77×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–155. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.29×10^1	9.31	6.02×10^{-4}	5.31×10^{-5}	6.33×10^{-4}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	2.82	6.09×10^{-4}	1.40×10^{-5}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	1.80	7.39×10^{-4}	1.07×10^{-5}	7.39×10^{-4}	5.72×10^{-2}	4.16×10^{-1}	2.85×10^{-6}	1.07×10^{-5}	1.11×10^{-5}
Off Site										
Columbia River	2.49×10^{-4}	7.45×10^{-3}	9.24×10^{-9}	1.85×10^{-10}	9.24×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1163. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

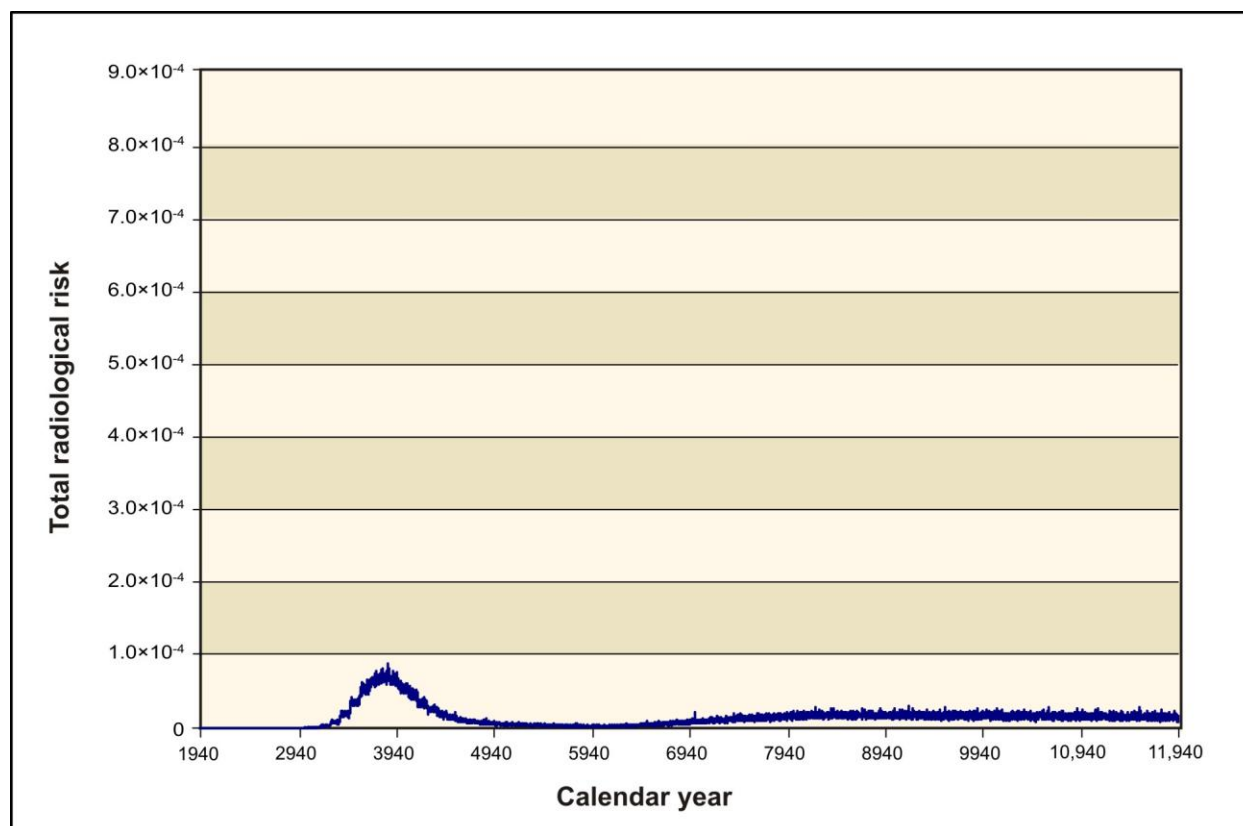


Figure 5-1164. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.7 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 1, Subgroup 1-G

Disposal Group 1, Subgroup 1-G, addresses the waste resulting from Tank Closure Alternative 6C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-156 and 5-157. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1165 and 5-1166, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5-1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.5×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from tank closure

secondary waste (65 percent of peak dose) and iodine-129 from ETF-generated secondary waste (35 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (4 percent of Hazard Index) and nitrate from ETF-generated secondary waste (96 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (1 percent of Hazard Index) and nitrate from ETF-generated secondary waste (99 percent of Hazard Index).

For the time series of risk at the Core Zone Boundary (see Figure 5-1166), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–156. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

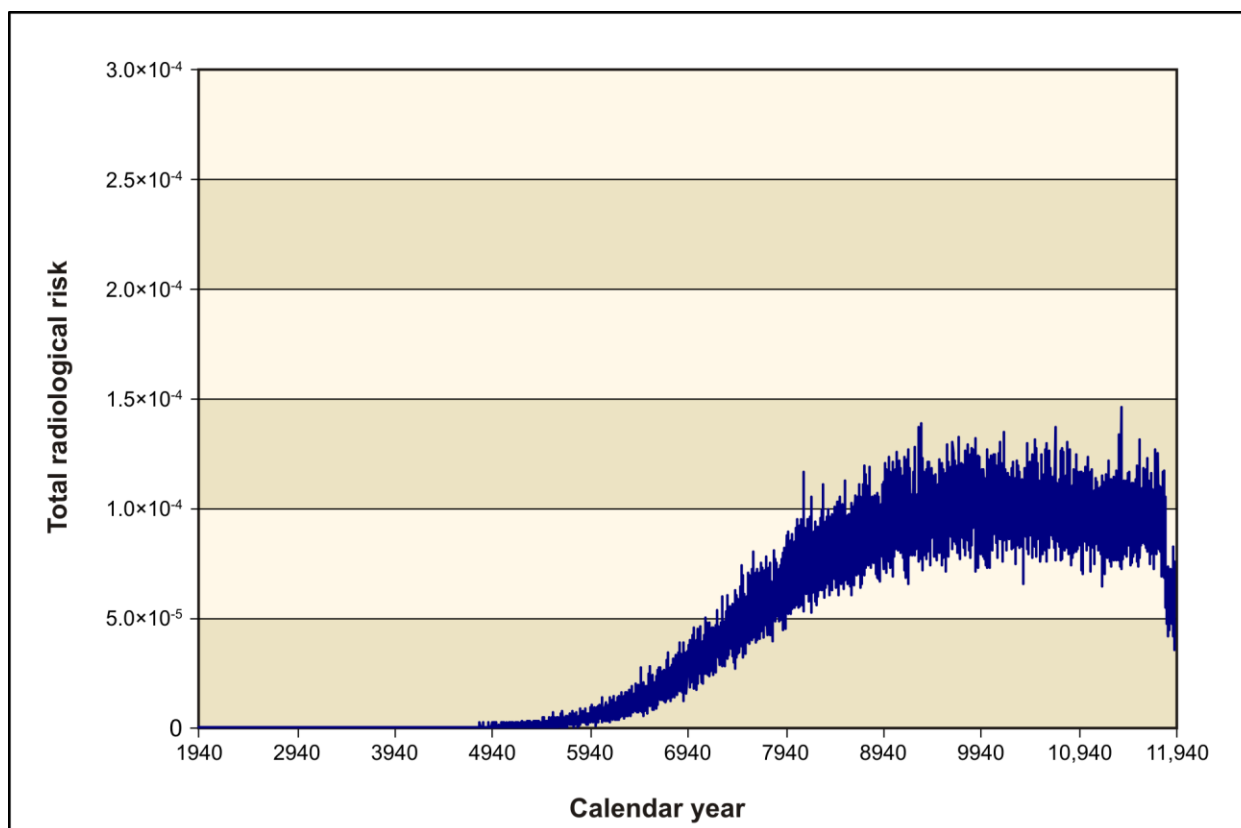
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.50×10^{-1}	2.29×10^{-1}	1.46×10^{-5}	0.00	1.46×10^{-5}	1.17	1.71	4.44×10^{-5}	8.05×10^{-12}	4.44×10^{-5}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	5.77×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.27×10^{-1}	2.81×10^{-4}	2.94×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	3.78×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.87×10^{-1}	3.41×10^{-4}	1.87×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	5.67×10^{-6}	2.79×10^{-9}	0.00	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–157. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.22	3.81	9.50×10^{-5}	3.69×10^{-7}	9.50×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	9.49×10^{-1}	6.09×10^{-4}	1.35×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	6.39×10^{-1}	7.39×10^{-4}	8.57×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	1.01×10^{-1}	2.85×10^{-6}	8.56×10^{-8}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.53×10^{-3}	9.31×10^{-9}	0.00	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1165. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

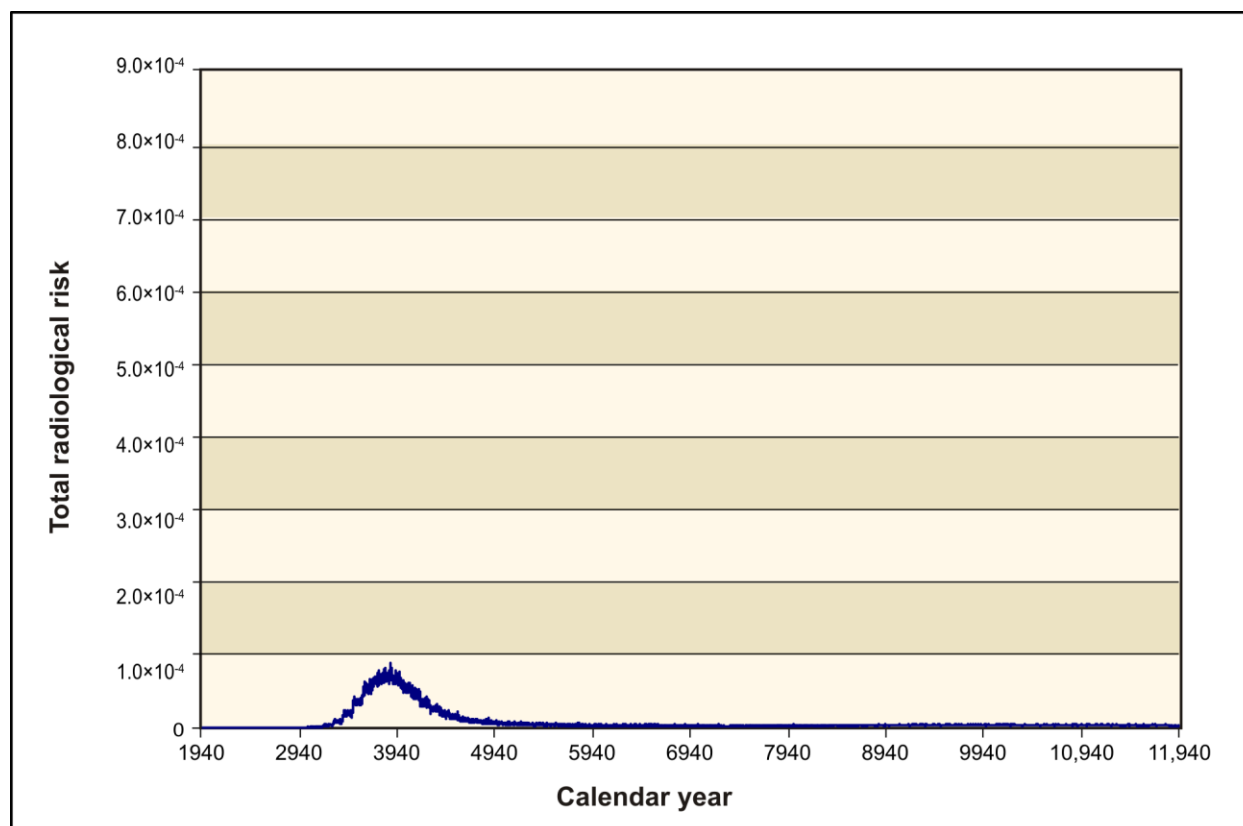


Figure 5-1166. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.8 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 2, Subgroup 2-A

Disposal Group 2, Subgroup 2-A, addresses the waste resulting from Tank Closure Alternative 2A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5-158 and 5-159. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.18×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1167 and 5-1168, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5-1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.3×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from tank closure

secondary waste (62 percent of peak dose) and iodine-129 from ETF-generated secondary waste (38 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (1 percent of Hazard Index) and nitrate from ETF-generated secondary waste (99 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (7 percent of Hazard Index) and nitrate from ETF-generated secondary waste (93 percent of Hazard Index).

For the time series of risk at the Core Zone Boundary (see Figure 5–1168), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–158. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

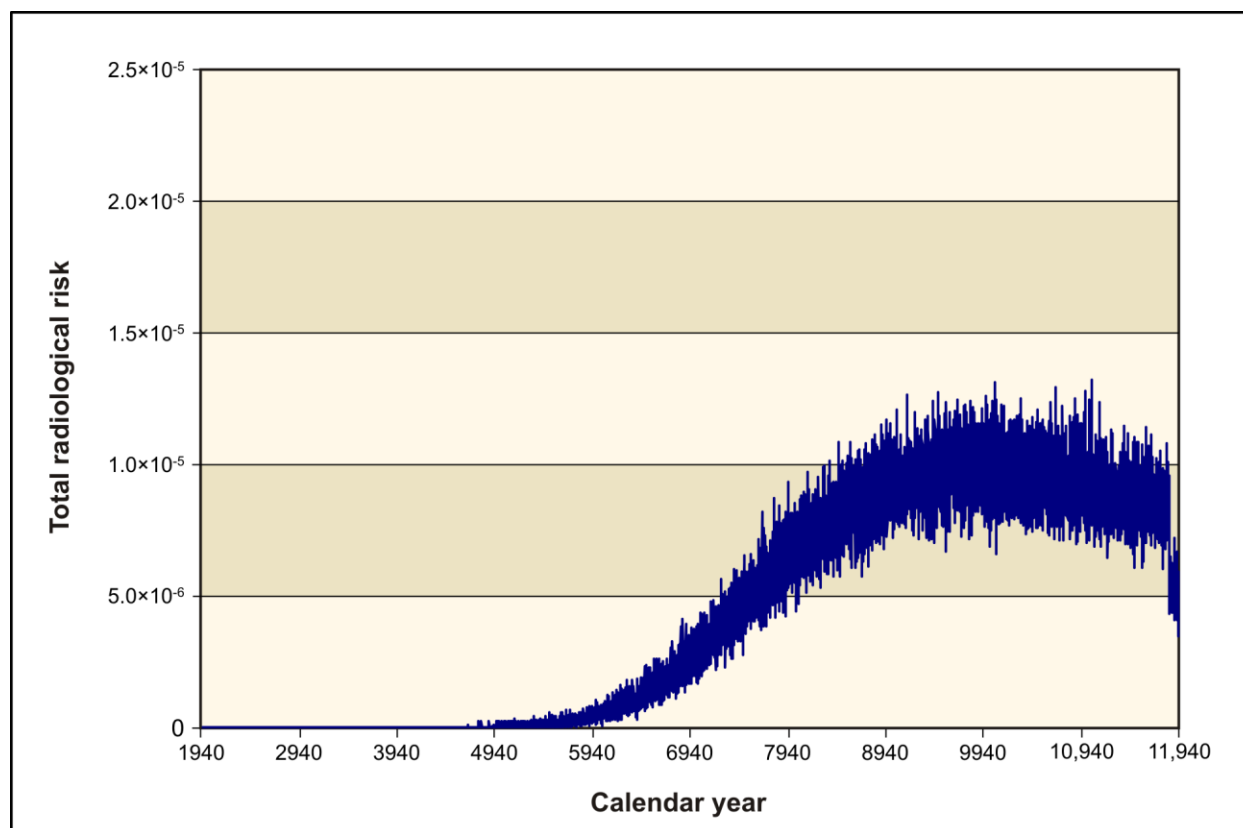
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	4.98×10^{-1}	1.77×10^{-1}	1.32×10^{-5}	0.00	1.32×10^{-5}	1.06	1.32	4.05×10^{-5}	6.97×10^{-12}	4.05×10^{-5}
IDF-West	2.87×10^{-1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{-1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	2.92	5.64×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.14×10^{-1}	2.81×10^{-4}	2.79×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	3.57×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.64×10^{-1}	3.41×10^{-4}	1.68×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.78×10^{-5}	5.37×10^{-6}	2.77×10^{-9}	0.00	2.77×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–159. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.00	2.93	8.71×10^{-5}	3.20×10^{-7}	8.72×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{-2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{-1}	9.20×10^{-1}	6.09×10^{-4}	1.28×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{-1}	5.87×10^{-1}	7.39×10^{-4}	7.68×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	9.13×10^{-2}	2.85×10^{-6}	7.68×10^{-8}	2.89×10^{-6}
Off Site										
Columbia River	2.49×10^{-4}	3.34×10^{-3}	9.24×10^{-9}	0.00	9.24×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1167. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

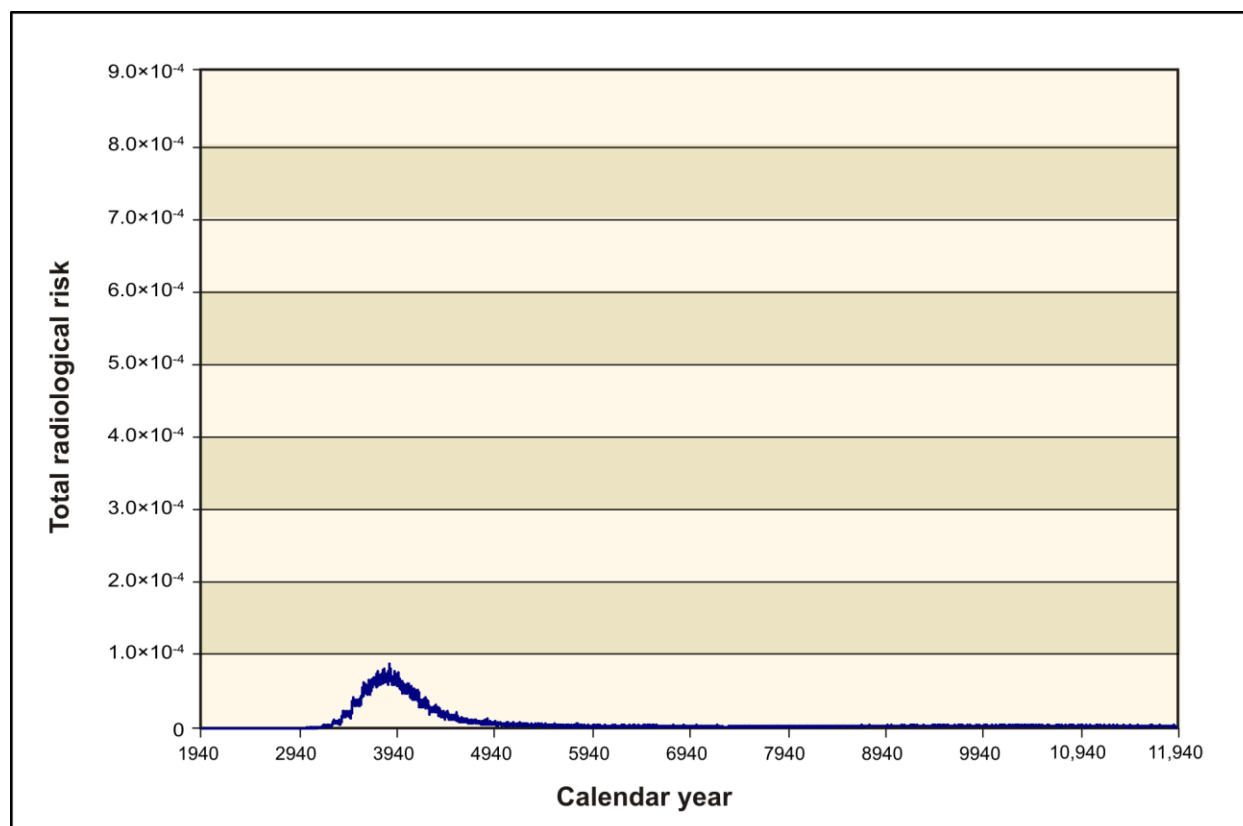


Figure 5–1168. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.9 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 2, Subgroup 2-B

Disposal Group 2, Subgroup 2-B, addresses the waste resulting from Tank Closure Alternative 6B (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–160 through 5–163. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer under both Base and Option Cases. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer under the Base Case. The Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer and would be exceeded at the Columbia River nearshore for the American Indian resident farmer under the Option Case. Population dose is estimated for Subgroup 2-B, Base Case, as 3.77×10^{-1} person-rem per year for the year of maximum impact and for Subgroup 2-B, Option Case, as 3.99×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.42×10^{-5} percent and 2.57×10^{-5} percent of the annual population dose due to background exposure for Subgroup 2-B, Base and Option Cases, respectively. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1169 and 5–1170 for the Base Case and in Figures 5–1171 and

5–1172 for the Option Case. The Base and Option Cases differ in the amount of constituents disposed of at the RPPDF because the Option Case includes removal of tank closure cribs and trenches (ditches). At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.4×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. Under both the Base and Option Cases at the IDF-East barrier, approximately 55 percent of the dose in the year of peak dose is due to technetium-99 released from tank closure secondary waste. The balance of dose in the year of peak dose is due to release of iodine-129 from ETF-generated secondary waste. Under both the Base and Option Cases at the Core Zone Boundary, approximately 82 percent of the dose in the year of peak dose is due to technetium-99, and approximately 18 percent of the peak dose is due to iodine-129. In each case, release is from offsite LLW. For chemical constituents under both the Base and Option Cases at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Base Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (93 percent of Hazard Index) and chromium (7 percent of Hazard Index) from ETF-generated secondary waste. For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

For the time series of risk at the Core Zone Boundary under the Base Case (see Figure 5–1170) and the Option Case (see Figure 5–1172), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide minor contributions to the early peak.

Table 5–160. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.27×10^{-1}	1.82×10^{-1}	1.36×10^{-5}	0.00	1.36×10^{-5}	1.08	1.36	4.13×10^{-5}	7.44×10^{-12}	4.13×10^{-5}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	3.26×10^{-1}	3.78×10^{-2}	9.96×10^{-6}	0.00	9.96×10^{-6}	7.68×10^{-1}	6.51×10^{-2}	3.17×10^{-5}	1.43×10^{-11}	3.17×10^{-5}
Core Zone Boundary	2.92	6.02×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.44×10^{-1}	2.81×10^{-4}	1.34×10^{-11}	2.81×10^{-4}
Columbia River nearshore	3.53	3.95×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.29	3.02×10^{-1}	3.41×10^{-4}	8.71×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.53×10^{-5}	5.38×10^{-6}	3.07×10^{-9}	1.73×10^{-16}	3.07×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–161. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	3.02	8.83×10^{-5}	3.41×10^{-7}	8.84×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.52	1.26×10^{-1}	6.86×10^{-5}	6.58×10^{-7}	6.91×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	9.86×10^{-1}	6.09×10^{-4}	6.13×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.64×10^1	6.72×10^{-1}	7.40×10^{-4}	3.99×10^{-7}	7.40×10^{-4}	5.74×10^{-2}	1.01×10^{-1}	2.86×10^{-6}	3.99×10^{-7}	3.03×10^{-6}
Off Site										
Columbia River	2.81×10^{-4}	3.35×10^{-3}	1.04×10^{-8}	7.93×10^{-12}	1.04×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–162. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.08×10 ⁻¹	2.78×10 ⁻¹	1.35×10 ⁻⁵	0.00	1.35×10 ⁻⁵	1.07	2.07	4.14×10 ⁻⁵	8.80×10 ⁻¹²	4.14×10 ⁻⁵
IDF-West	2.87×10 ¹	1.03×10 ⁻²	8.59×10 ⁻⁴	0.00	8.59×10 ⁻⁴	6.66×10 ¹	1.17×10 ⁻²	2.72×10 ⁻³	4.13×10 ⁻¹²	2.72×10 ⁻³
River Protection Project Disposal Facility	4.70×10 ⁻¹	4.41×10 ⁻¹	1.42×10 ⁻⁵	0.00	1.42×10 ⁻⁵	1.10	1.61	4.50×10 ⁻⁵	1.33×10 ⁻¹⁰	4.50×10 ⁻⁵
Core Zone Boundary	2.92	3.75×10 ⁻¹	8.86×10 ⁻⁵	0.00	8.86×10 ⁻⁵	6.84	1.22	2.81×10 ⁻⁴	1.12×10 ⁻¹⁰	2.81×10 ⁻⁴
Columbia River nearshore	3.52	2.60×10 ⁻¹	1.07×10 ⁻⁴	0.00	1.07×10 ⁻⁴	8.28	7.30×10 ⁻¹	3.41×10 ⁻⁴	7.56×10 ⁻¹¹	3.41×10 ⁻⁴
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.98×10 ⁻⁵	2.03×10 ⁻⁵	3.25×10 ⁻⁹	1.55×10 ⁻¹⁵	3.25×10 ⁻⁹

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–163. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	4.60	8.87×10 ⁻⁵	4.04×10 ⁻⁷	8.89×10 ⁻⁵	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10 ²	1.87×10 ⁻²	5.87×10 ⁻³	1.89×10 ⁻⁷	5.87×10 ⁻³	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.16	3.43	9.75×10 ⁻⁵	6.11×10 ⁻⁶	1.01×10 ⁻⁴	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10 ¹	2.57	6.09×10 ⁻⁴	5.15×10 ⁻⁶	6.12×10 ⁻⁴	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10 ¹	1.52	7.39×10 ⁻⁴	3.47×10 ⁻⁶	7.40×10 ⁻⁴	5.74×10 ⁻²	2.83×10 ⁻¹	2.86×10 ⁻⁶	3.47×10 ⁻⁶	5.43×10 ⁻⁶
Off Site										
Columbia River	2.98×10 ⁻⁴	1.04×10 ⁻²	1.10×10 ⁻⁸	7.10×10 ⁻¹¹	1.11×10 ⁻⁸	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

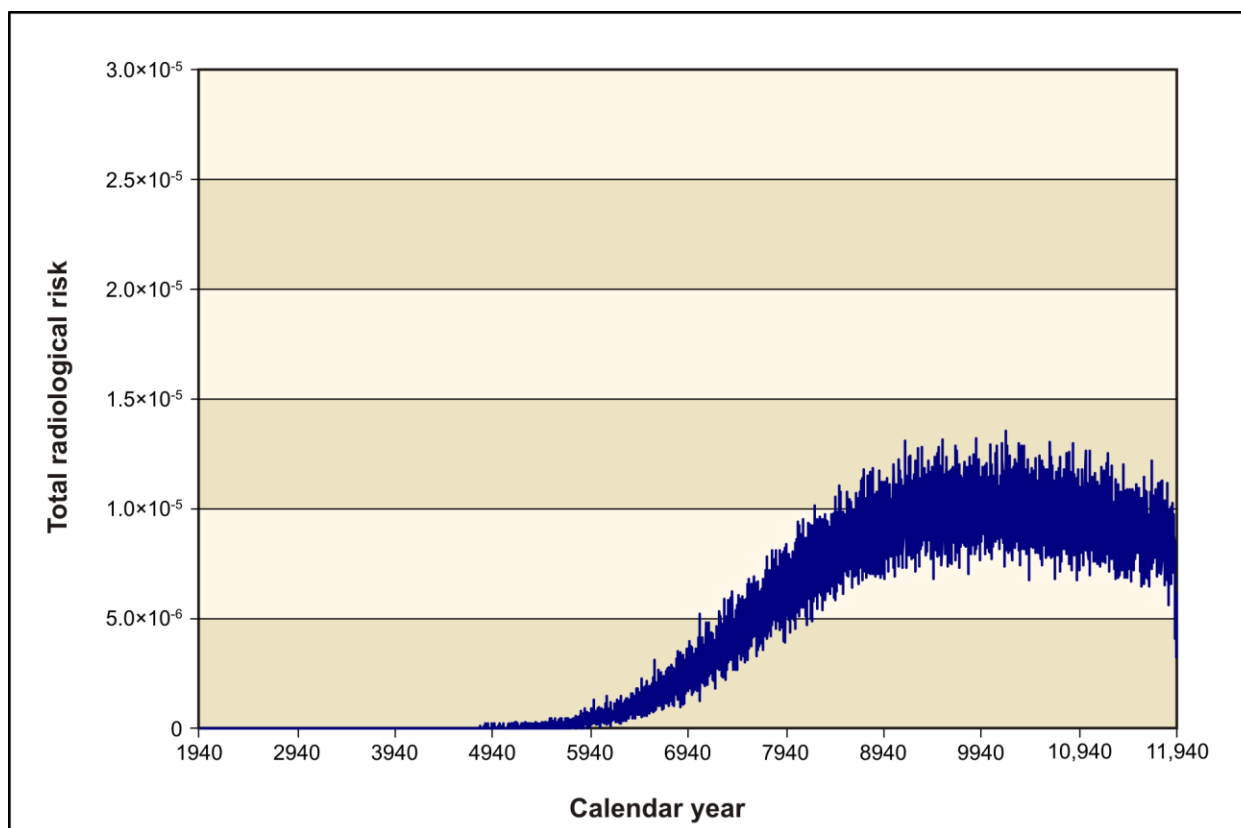


Figure 5–1169. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

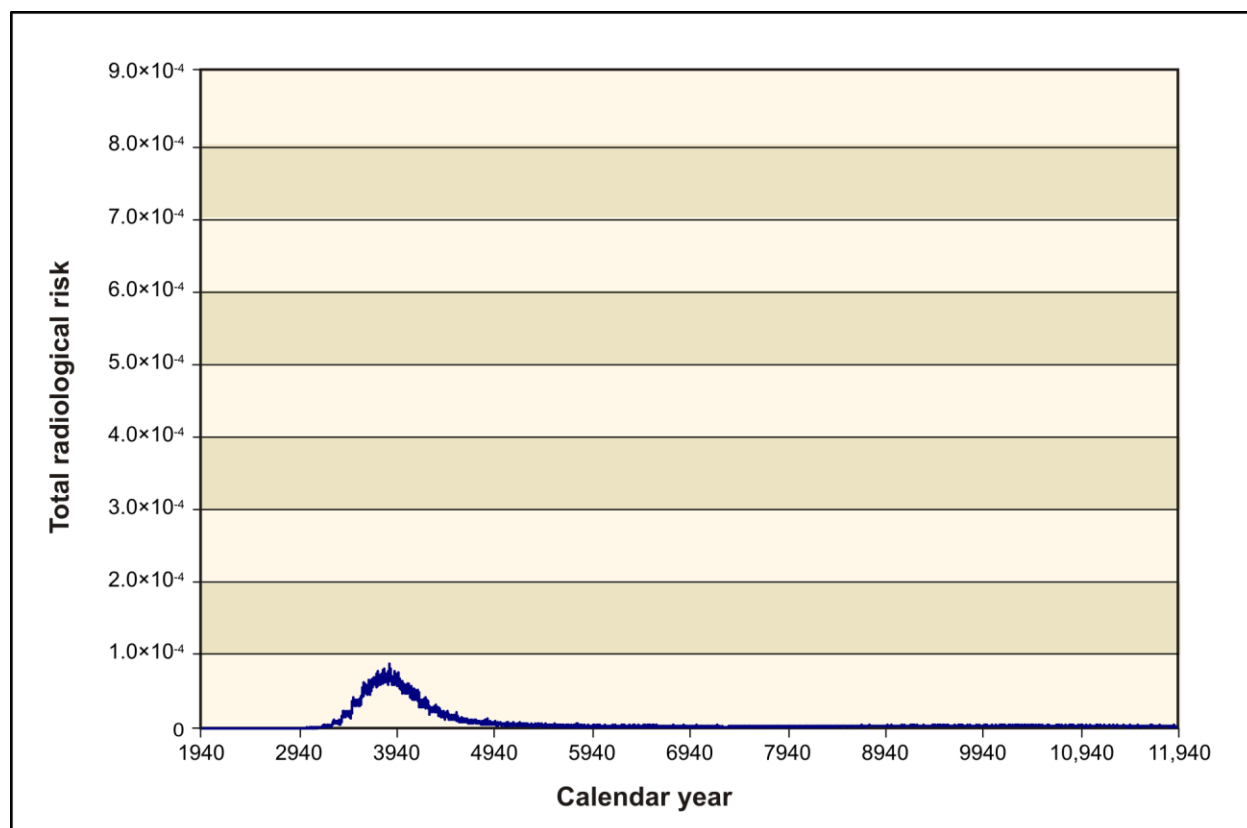


Figure 5–1170. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

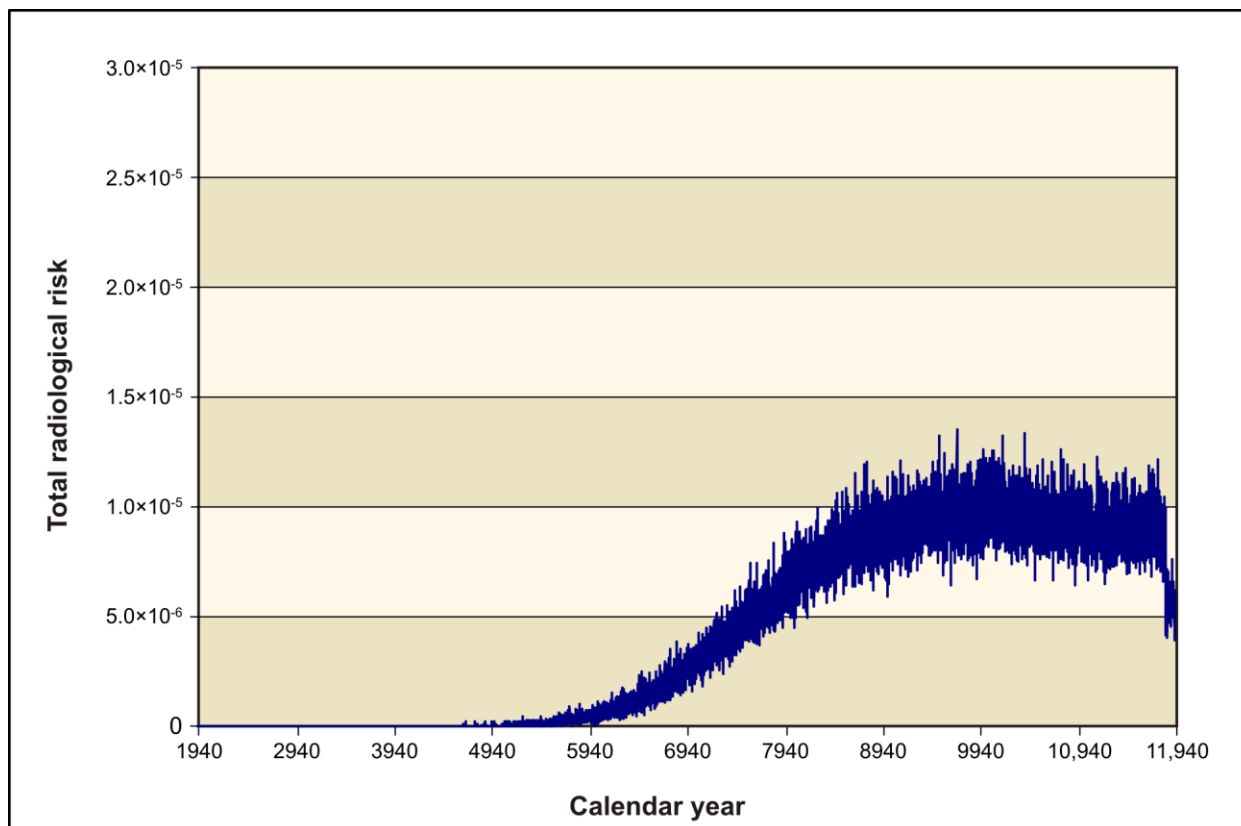
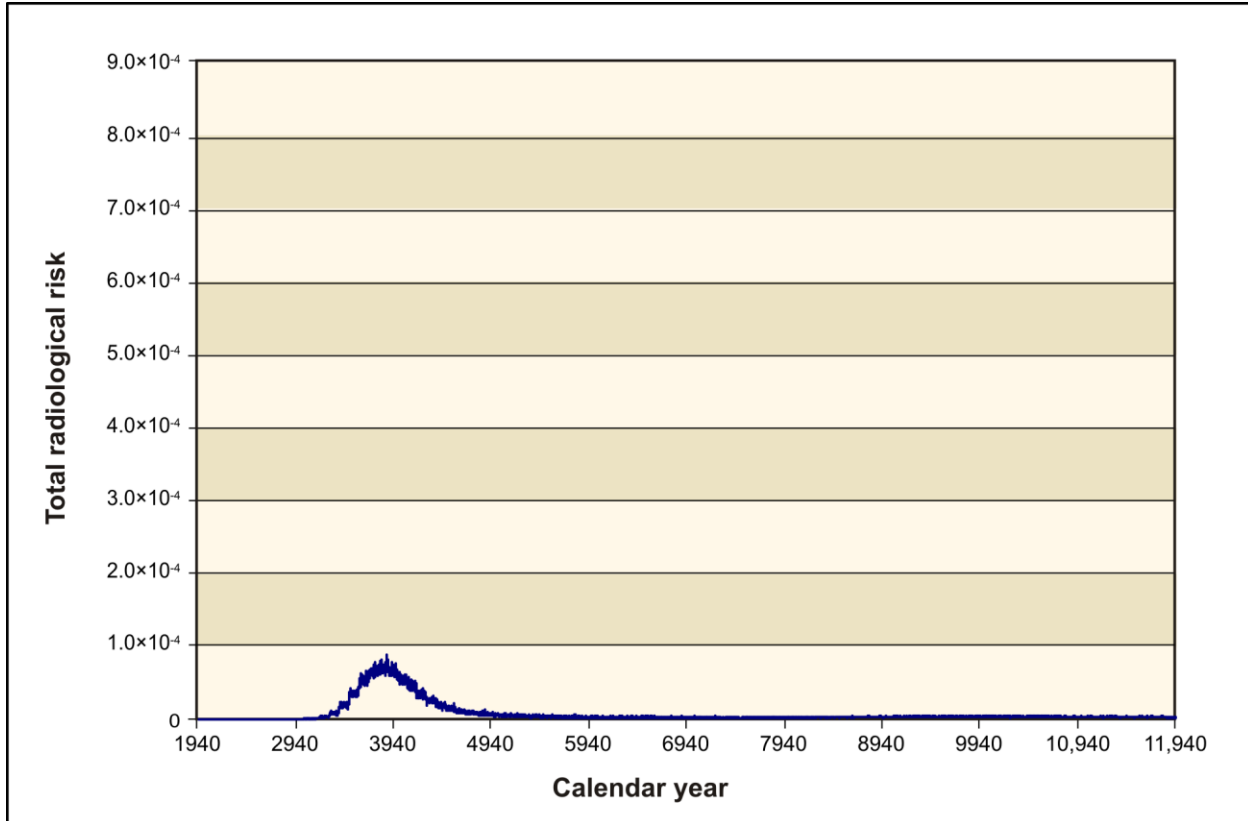


Figure 5–1171. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier



**Figure 5-1172. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B,
Option Case, Time Series of Radiological Risk for the Drinking-Water Well User
at the Core Zone Boundary**

5.3.2.3.10 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, Disposal Group 3

Disposal Group 3 addresses the waste resulting from Tank Closure Alternative 6A (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Table 5-92 provides a listing of the waste types and disposal locations considered under this disposal group.

Potential human health impacts of this alternative are summarized in Tables 5-164 through 5-167. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer under both the Base and Option Cases. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer under the Base Case. The Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer and would be exceeded at the Columbia River nearshore for the American Indian resident farmer under the Option Case. Population dose is estimated for Disposal Group 3, Base Case, as 3.76×10^{-1} person-rem per year for the year of maximum impact and for Disposal Group 3, Option Case, as 3.98×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.42×10^{-5} percent and 2.56×10^{-5} percent of the annual population dose due to background exposure for Disposal Group 3, Base and Option Cases, respectively. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5-1173 and 5-1174 for the Base Case and in Figures 5-1175 and 5-1176 for the Option Case. The Base and Option Cases differ in the amount of constituents disposed of

at the RPPDF because the Option Case includes removal of tank closure cribs and trenches (ditches). At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.4×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. Under both the Base and Option Cases at the IDF-East barrier, approximately 55 percent of the dose in the year of peak dose is due to technetium-99 released from tank closure secondary waste. The balance of dose in the year of peak dose is due to release of iodine-129 from ETF-generated secondary waste. Under both the Base and Option Cases at the Core Zone Boundary, approximately 82 percent of the dose in the year of peak dose is due to technetium-99 and approximately 18 percent of the peak dose is due to iodine-129. In each case, release is from offsite LLW. For chemical constituents under both the Base and Option Cases at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Base Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (93 percent of Hazard Index) from ETF-generated secondary waste and chromium (7 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

For the time series of risk at the Core Zone Boundary under the Base Case (see Figure 5–1174) and the Option Case (see Figure 5–1176), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide minor contributions to the early peak.

Table 5–164. Waste Management Alternative 3, Disposal Group 3, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.27×10^{-1}	1.82×10^{-1}	1.36×10^{-5}	0.00	1.36×10^{-5}	1.08	1.36	4.13×10^{-5}	7.44×10^{-12}	4.13×10^{-5}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	3.14×10^{-1}	3.92×10^{-2}	9.51×10^{-6}	0.00	9.51×10^{-6}	7.35×10^{-1}	7.03×10^{-2}	3.02×10^{-5}	1.48×10^{-11}	3.02×10^{-5}
Core Zone Boundary	2.92	6.02×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.44×10^{-1}	2.81×10^{-4}	1.29×10^{-11}	2.81×10^{-4}
Columbia River nearshore	3.52	3.95×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	3.02×10^{-1}	3.41×10^{-4}	8.11×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.52×10^{-5}	5.38×10^{-6}	3.06×10^{-9}	1.74×10^{-16}	3.06×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–165. Waste Management Alternative 3, Disposal Group 3, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	3.02	8.83×10^{-5}	3.41×10^{-7}	8.84×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.45	1.31×10^{-1}	6.53×10^{-5}	6.79×10^{-7}	6.58×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	9.86×10^{-1}	6.09×10^{-4}	5.90×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	6.72×10^{-1}	7.39×10^{-4}	3.72×10^{-7}	7.39×10^{-4}	5.73×10^{-2}	1.01×10^{-1}	2.86×10^{-6}	3.72×10^{-7}	2.99×10^{-6}
Off Site										
Columbia River	2.80×10^{-4}	3.35×10^{-3}	1.03×10^{-8}	7.98×10^{-12}	1.03×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–166. Waste Management Alternative 3, Disposal Group 3, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

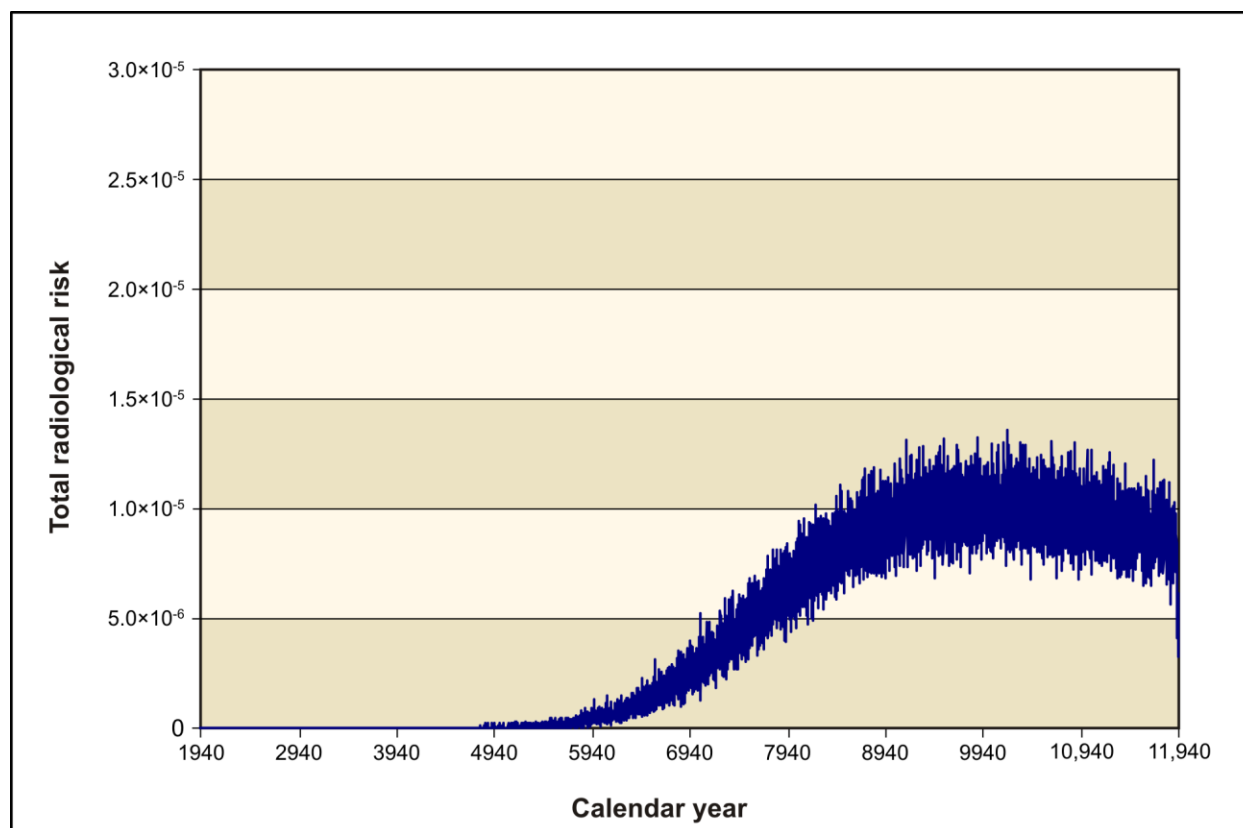
Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.08×10^{-1}	2.78×10^{-1}	1.35×10^{-5}	0.00	1.35×10^{-5}	1.07	2.07	4.14×10^{-5}	8.80×10^{-12}	4.14×10^{-5}
IDF-West	2.87×10^1	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^1	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	4.75×10^{-1}	4.39×10^{-1}	1.49×10^{-5}	0.00	1.49×10^{-5}	1.14	1.53	4.77×10^{-5}	1.27×10^{-10}	4.77×10^{-5}
Core Zone Boundary	2.92	3.75×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.33	2.81×10^{-4}	1.12×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	2.60×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	8.40×10^{-1}	3.41×10^{-4}	8.22×10^{-11}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.96×10^{-5}	2.02×10^{-5}	3.24×10^{-9}	1.53×10^{-15}	3.24×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–167. Waste Management Alternative 3, Disposal Group 3, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	4.60	8.87×10^{-5}	4.04×10^{-7}	8.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^2	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.27	3.24	1.04×10^{-4}	5.82×10^{-6}	1.07×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^1	2.79	6.09×10^{-4}	5.12×10^{-6}	6.13×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^1	1.79	7.39×10^{-4}	3.77×10^{-6}	7.40×10^{-4}	5.73×10^{-2}	2.87×10^{-1}	2.86×10^{-6}	3.77×10^{-6}	5.72×10^{-6}
Off Site										
Columbia River	2.98×10^{-4}	1.03×10^{-2}	1.10×10^{-8}	7.02×10^{-11}	1.10×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.



**Figure 5–1173. Waste Management Alternative 3, Disposal Group 3, Base Case,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

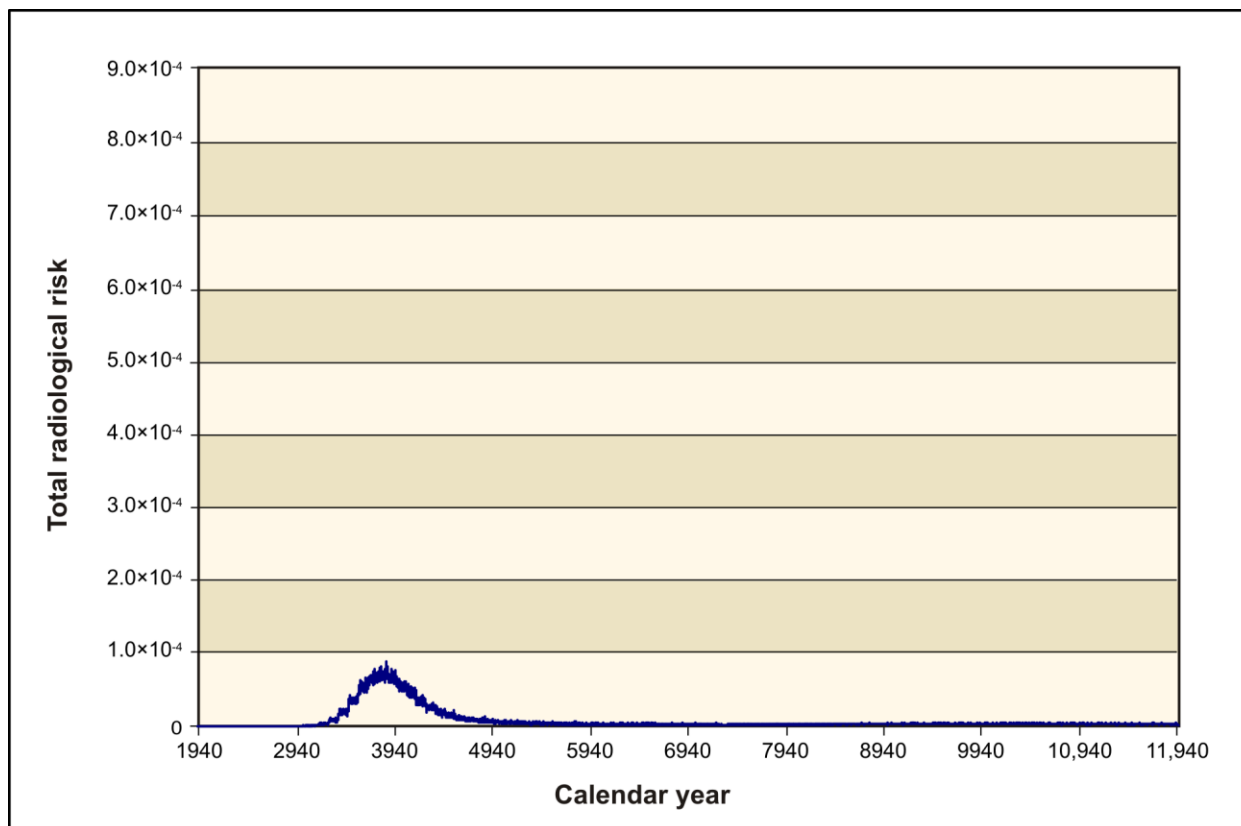
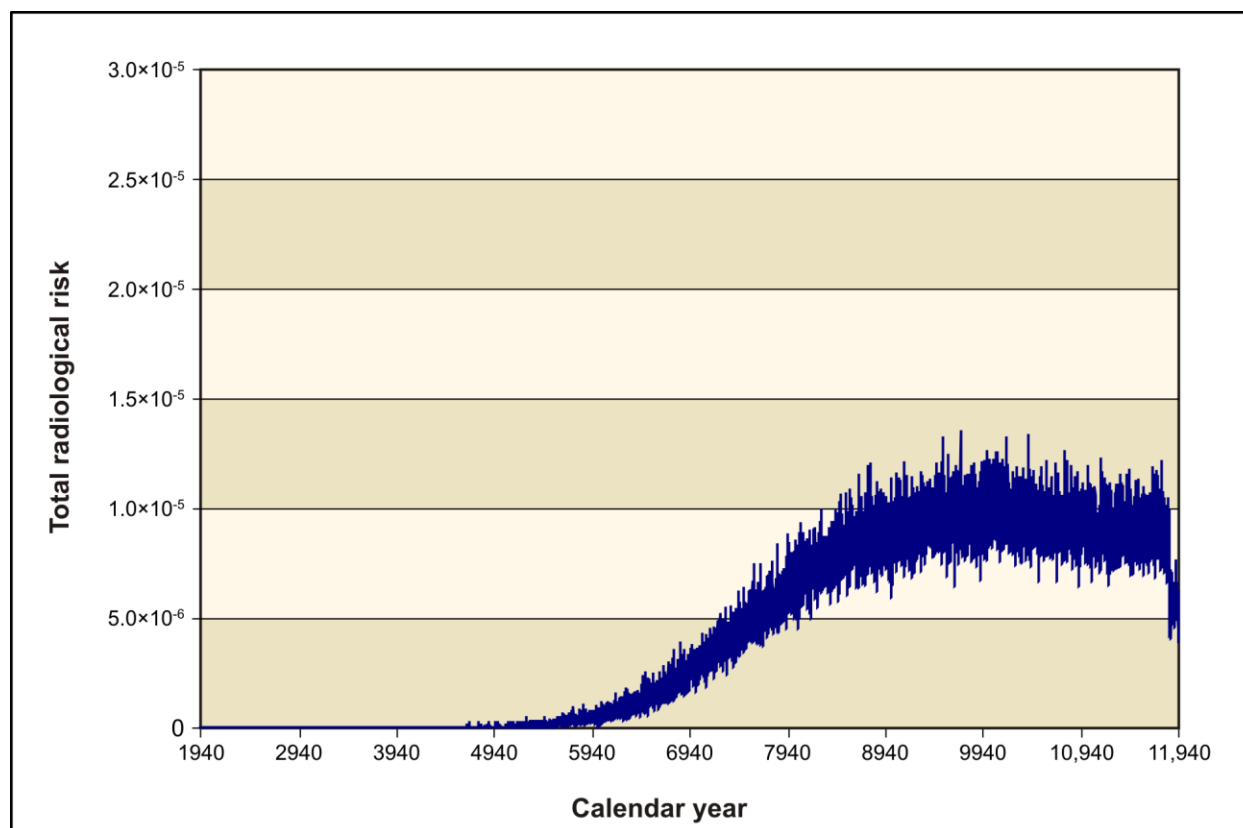


Figure 5–1174. Waste Management Alternative 3, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary



**Figure 5–1175. Waste Management Alternative 3, Disposal Group 3, Option Case,
Time Series of Radiological Risk for the Drinking-Water Well User
at the 200-East Area Integrated Disposal Facility Barrier**

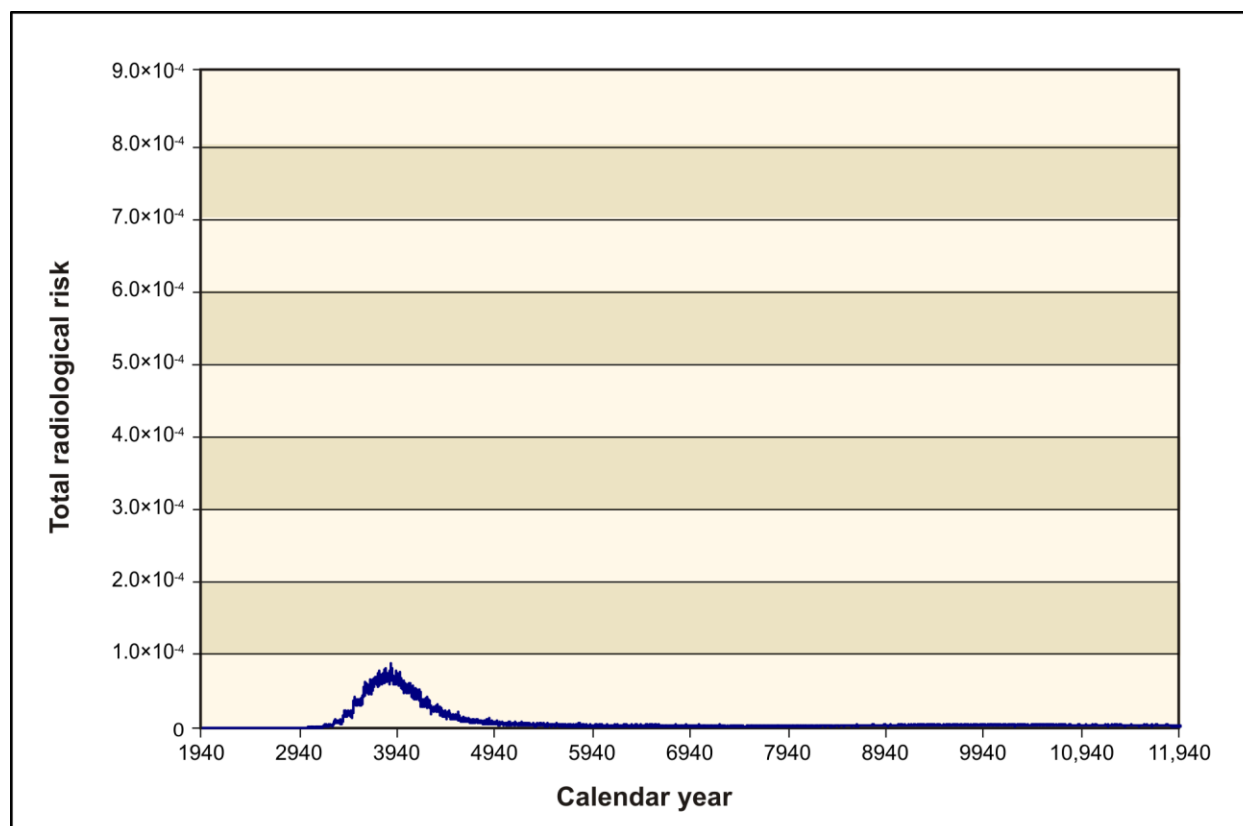


Figure 5–1176. Waste Management Alternative 3, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.4 Waste Management Intruder Scenario

Intruders are individuals who enter IDF-East, IDF-West, or the RPPDF and engage in activity that could cause direct contact with residual contamination in the stabilized, below-grade waste. Waste types that would be disposed of in IDF-East and IDF-West include waste generated during activities related to tank closure and activities not related to tank closure. Waste types related to tank closure that would be disposed of in IDF-East include:

- ILAW glass
- Bulk vitrification glass
- Cast stone waste
- Steam reforming waste
- PPF glass
- ETF-generated secondary waste
- Sulfate grout
- Tank closure secondary waste
- Discarded melters

In addition, rubble, soil and equipment generated during tank closure activities would be disposed of in the RPPDF under some Tank Closure alternatives. Waste types not related to tank closure that would be disposed of in either IDF-East or IDF-West include:

- Onsite non-CERCLA waste
- Waste management secondary waste
- Offsite waste
- FFTF decommissioning secondary waste

As in the case of Tank Closure alternatives, two types of receptors and two types of scenarios were considered. The receptor types were the resident farmer and American Indian resident farmer, and the scenario types were home construction and well drilling. Because the waste at the disposal areas is at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker involved in well drilling would be the same for the resident farmer and American Indian resident farmer. Screening analysis also determined that impacts of intrusion were dominated by contact with short-lived radionuclides, strontium-90 and cesium-137, for all waste types except ETF-generated secondary waste. Consequently, impacts of intrusion at the disposal areas are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose; the year of peak dose occurs immediately after loss of institutional control.

The impacts under this intrusion scenario at IDF-East or IDF-West for waste types related to tank closure are summarized in Tables 5-168 and 5-169 for the American Indian resident farmer and worker intruders, respectively. For all waste types and alternatives except ETF-generated secondary waste, resident farmer impacts are dominated by exposure to strontium-90 and cesium-137. Estimates of impact on the drilling worker are dominated by external exposure due to cesium-137. For both the American Indian resident farmer and drilling worker, impacts related to ETF-generated secondary waste are dominated by exposure to iodine-129. Due to high waste loadings of cesium-137, the DOE intruder dose guideline of 500 millirem is exceeded for both primary- and secondary-waste forms for residential agriculture intruders, but is not exceeded for intruder workers. The estimated impacts of intrusion into the rubble, soil and equipment related to tank closure that is disposed of in the RPPDF are presented in Table 5-170. As for other tank closure waste types, doses are dominated by exposure to cesium-137. The DOE intruder dose guideline is not exceeded for any Tank Closure alternatives for either type of intruder. The estimated impacts of intrusion into waste types not related to tank closure that are disposed of in either IDF-East or IDF-West are presented in Table 5-171 for an American Indian resident farmer and a drilling worker. The DOE intruder dose guideline of 500 millirem is exceeded for offsite waste due to high loading of cesium-137, but is not exceeded for the intruder worker for any of the four types of waste.

Table 5–168. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture Following Well Drilling at an Integrated Disposal Facility

Alternative	Dose (rem per year)								
	Waste Type								
	ILAW Glass	Bulk Vitrification Glass	Cast Stone Waste	Steam Reforming Waste	PPF Glass	ETF-Generated Secondary Waste	Sulfate Grout	Tank Closure Secondary Waste	Discarded Melters
2A	0.74	N/A ^a	N/A ^a	N/A ^a	N/A ^a	0.34	N/A ^a	1.22	0.028
2B	0.74	N/A ^a	N/A ^a	N/A ^a	N/A ^a	0.34	N/A ^a	1.30	0.028
3A	0.93	7.7	N/A ^a	N/A ^a	N/A ^a	0.56	N/A ^a	1.64	0.035
3B	0.93	N/A ^a	5.9	N/A ^a	N/A ^a	0.26	N/A ^a	2.19	0.035
3C	0.93	N/A ^a	N/A ^a	7.7	N/A ^a	0.56	N/A ^a	2.20	0.035
4	1.30	18.6	0.47	N/A ^a	N/A ^a	0.62	N/A ^a	1.84	0.048
5	1.24	20.5	0.46	N/A ^a	N/A ^a	0.54	0.47	1.41	0.046
6A, Base Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	38.1	0.34	N/A ^a	1.46	0.91
6A, Option Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	1.90	0.34	N/A ^a	1.36	0.039
6B, Base Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	38.1	0.34	N/A ^a	1.46	0.91
6B, Option Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	1.90	0.34	N/A ^a	1.36	0.039
6C	N/A ^a	N/A ^a	N/A ^a	N/A ^a	N/A ^a	0.34	N/A ^a	1.30	N/A ^a

^a Not applicable because this waste type would not be generated under this alternative.

Key: ETF=Effluent Treatment Facility; ILAW=immobilized low-activity waste; N/A=not applicable; PPF=Preprocessing Facility.

Table 5–169. Doses by Tank Closure Waste Type to a Well-Drilling Worker at an Integrated Disposal Facility

Alternative	Dose (rem)								
	Waste Type								
	ILAW Glass	Bulk Vitrification Glass	Cast Stone Waste	Steam Reforming Waste	PPF Glass	ETF-Generated Secondary Waste	Sulfate Grout	Tank Closure Secondary Waste	Discarded Melters
2A	1.6×10^{-3}	N/A ^a	N/A ^a	N/A ^a	N/A ^a	2.6×10^{-4}	N/A ^a	1.9×10^{-3}	5.8×10^{-5}
2B	1.6×10^{-3}	N/A ^a	N/A ^a	N/A ^a	N/A ^a	2.6×10^{-4}	N/A ^a	2.1×10^{-3}	5.8×10^{-5}
3A	2.0×10^{-3}	1.7×10^{-2}	N/A ^a	N/A ^a	N/A ^a	5.8×10^{-4}	N/A ^a	2.5×10^{-3}	7.3×10^{-5}
3B	2.0×10^{-3}	N/A ^a	1.3×10^{-2}	N/A ^a	N/A ^a	2.0×10^{-4}	N/A ^a	3.4×10^{-3}	7.3×10^{-5}
3C	2.0×10^{-3}	N/A ^a	N/A ^a	1.6×10^{-2}	N/A ^a	5.8×10^{-4}	N/A ^a	3.4×10^{-3}	7.3×10^{-5}
4	2.7×10^{-3}	4.0×10^{-2}	9.9×10^{-4}	N/A ^a	N/A ^a	6.8×10^{-4}	N/A ^a	2.8×10^{-3}	1.0×10^{-4}
5	2.6×10^{-3}	4.4×10^{-2}	9.6×10^{-4}	N/A ^a	N/A ^a	5.8×10^{-4}	9.9×10^{-4}	2.2×10^{-3}	9.7×10^{-5}
6A, Base Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	7.9×10^{-2}	2.6×10^{-4}	N/A ^a	2.3×10^{-3}	1.9×10^{-3}
6A, Option Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	6.0×10^{-3}	2.6×10^{-4}	N/A ^a	2.2×10^{-3}	1.2×10^{-4}
6B, Base Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	7.9×10^{-2}	2.6×10^{-4}	N/A ^a	2.3×10^{-3}	1.9×10^{-3}
6B, Option Case	N/A ^a	N/A ^a	N/A ^a	N/A ^a	6.0×10^{-3}	2.6×10^{-4}	N/A ^a	2.2×10^{-3}	1.2×10^{-4}
6C	N/A ^a	N/A ^a	N/A ^a	N/A ^a	N/A ^a	2.6×10^{-4}	N/A ^a	2.1×10^{-3}	N/A ^a

^a Not applicable because this waste type would not be generated under this alternative.

Key: ETF=Effluent Treatment Facility; ILAW=immobilized low-activity waste; N/A=not applicable; PPF=Preprocessing Facility.

Table 5–170. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture and a Well-Drilling Worker at the RPPDF

Alternative	Dose for American Indian Resident Farmer (rem per year)	Dose for Drilling Worker (rem per year)
2A	N/A ^a	N/A ^a
2B	0.017	3.3×10^{-5}
3A	0.017	3.3×10^{-5}
3B	0.017	3.3×10^{-5}
3C	0.017	3.3×10^{-5}
4	0.044	8.9×10^{-5}
5	N/A ^a	N/A ^a
6A, Base Case	0.053	1.1×10^{-4}
6A, Option Case	0.016	3.5×10^{-5}
6B, Base Case	0.053	1.1×10^{-4}
6B, Option Case	0.016	3.5×10^{-5}
6C	0.017	3.3×10^{-5}

^a Not applicable because the RPPDF would not be constructed under this alternative.

Key: N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table 5–171. Doses by Waste Management Waste Type to an American Indian Engaged in Residential Agriculture and a Well-Drilling Worker at an Integrated Disposal Facility

Waste Type	Dose for American Indian Resident Farmer (rem per year)	Dose for Drilling Worker (rem per year)
Onsite non-CERCLA waste	0.179	4.4×10^{-4}
Waste management secondary waste	6.6×10^{-4}	3.0×10^{-6}
Offsite waste	2.62	5.1×10^{-3}
FFTF decommissioning secondary waste	0.0034	1.4×10^{-5}

Key: CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; FFTF=Fast Flux Test Facility.